VARIABILITY CHARACTER ASSOCIATION AND PATH CO-EFFICIENT ANALYSIS OF RIDGE GOURD

MD. MOSIUR RAHMAN BHUYIN APU

DEPARTMENT OF HORTICULTURE
SHER-E-BANGLA AGRICULTURAL UNIVERSITY
DHAKA-1207

JUNE, 2013

VARIABILITY CHARACTER ASSOCIATION AND PATH CO-EFFICIENT ANALYSIS OF RIDGE GOURD

BY

MD. MOSIUR RAHMAN BHUYIN APU

Reg. No. 06-02139

A Thesis
Submitted to the Department of Horticulture
Sher-e-Bangla Agricultural University, Dhaka
In partial fulfillment of the requirements
for the degree
of

MASTER OF SCIENCE (MS)
IN
HORTICULTURE

SEMESTER: JANUARY-JUNE, 2013

APPROVED BY:

Prof. Dr. Md. Ismail Hossain
Department of Horticulture
SAU, Dhaka
Supervisor

Dr. Satya Ranjan Saha
Associate Professor
Department of Agroforestry and Environment
BSMRAU, Joydebpur, Gazipur
Co-Supervisor

Prof. Md. Hasanuzzaman Akand
Chairman
Examination Committee

Memo No: SAU/HORT/………………………………………………

CERTIFICATE

This is to certify that the thesis entitled **"Variability character association and path co-efficient analysis of ridge gourd"** submitted to the Department of Horticulture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **Master of Science in Horticulture**, embodies the result of a piece of *bona fide* research work carried out by **Md. Mosiur Rahman Bhuyin Apu**, Registration No. **06-02139** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

I further certify that any help or source of information, received during the course of this investigation has been duly acknowledged.

Date: June, 2013
Dhaka, Bangladesh

Prof. Dr. Md. Ismail Hossain
Department of Horticulture
Sher-e-Bangla Agricultural University
Dhaka-1207
Supervisor

DEDICATED

TO

MY BELOVED PARENTS

ACKNOWLEDGEMENTS

All praises to Almightly Allah for His never-ending blessing, the author deems it a great pleasure to express his profound gratitude to his respected parents, who entiled much hardship inspiring for prosecuting his studies.

*The author likes to express his deepest sense of gratitude to his respected supervisor Professor, **Dr. Md. Ismail Hossain**, Department of Horticulture, Sher-e-Bangla Agricultural University (SAU), Dhaka, Bangladesh for his scholastic guidance, support, encouragement, valuable suggestions and constructive criticism throughout the study period and gratuitous labor in conducting and successfully completing the research work and in the preparation of the manuscript.*

*The author also expresses his gratefulness to his respected Co-Supervisor Associate Professor, **Dr. Satya Ranjan Saha**, Department of Agroforestry and Environment, BSMRAU, Joydebpur, Gazipur for his scholastic guidance, helpful comments and constant inspiration, inestimatable help, valuable suggestions throughout the research work and in preparation of the thesis.*

*The author expresses his sincere gratitude towards the sincerity of the Professor, **Md. Hasanuzzaman Akand**, Chairman, Department of Horticulture, SAU, Dhaka for his valuable suggestions and cooperation during the study period. The author also expresses heartfelt thanks to all the teachers of the Department of Horticulture, SAU for their valuable suggestions, instructions, cordial help and encouragement during the study period.*

The author expresses his sincere appreciation to his brother, sisters, relatives, well wishers and friends for their inspiration, help and encouragement throughout the study period.

The Author

VARIABILITY CHARACTER ASSOCIATION AND PATH CO-EFFICIENT ANALYSIS OF RIDGE GOURD

BY

MD. MOSIUR RAHMAN BHUYIN APU

ABSTRACT

The experiment was carried out during the period from April to August 2012 at the Regional Horticulture Research Station, Narsingdi. In this experiment nine collected lines and one local germplasm of ridge gourd were used as test crop. The single factor experiment was laid out in a Randomized Complete Block Design with three replications. The highest weight of individual fruit (137.55 g) was obtained in LA-211 and the lowest weight (73.55 g) in LA-208. The highest fruit yield (22.41 t/ha) was found in LA-211 and the lowest yield (8.04 t/ha) in LA-210. For 10 traits phenotypic variation was higher than the genotypic variance with moderate to high heritability and moderate genetic advance and in percentage of mean. Positive significant association was observed for fruit yield/ha in respect of individual fruit weight (0.526), number of fruits/plant (0.711), fruit yield/plant (0.968) and fruit yield/hectare (1.00), while significant negative association was observed for days required to 1st harvest (-0.390). Path analysis revealed that all the parameter showed positive direct effect except days to 1st harvest and weight of 100 seeds. On the basis of performance study, the genotype LA-211 was found to be most promising in order to develop a ridge gourd variety.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF APPENDICES

CHAPTER I

INTRODUCTION

Ridge gourd (*Luffa acutangula* L.) belongs to the family Cucurbitaceae is one of the most important cucurbitaceous vegetable crops and grown extensively throughout the tropical and subtropical regions of the world. The name “Luff” or “Loofah” is an Arabic origin and refers to the spongy characteristic of the mature fruit (Bose and Som, 1986). Its origin is not definitely known, although wild forms are available in India, the Sunda Island and Java (Yawalkar, 1985). Now, it is cultivated in Bangladesh, China and different region of India such as Asam, West Bengal, Uttar Pradesh and in some other countries (Bose and Som, 1986). There are eight species of Cucurbits originated in Indian Sub-continent of which only two *L. acutangula* and *L. cylindrica* are important vegetable crops, while the other species are wild type.

The tender fruits of ridge gourd is a popular and well known for culinary vegetable in our country with good nutritive value and high yield potential. The fruits contain Vitamin A, C and iron. Its use is recommended for those who suffer from malaria and other seasonal fever for its easy digestibility and very appetizing quality (Yawalkar, 1985). The total production of ridge gourd in Bangladesh was about 36,000 metric ton in 8,600 hectare of land with an average yield 4.19 ton/ha (BBS, 2011). This figure indicates the low yield of this crop and the low yield in Bangladesh however, is not an indication of low yielding potentiality of this crop, but may be attributed to a number of reasons, viz. unavailability of quality seeds of high yielding varieties in appropriate time, fertilizer management, disease and insect infestation, improper or limited irrigation facilities and other appropriate agronomic practices. Among the factors genotypes/cultivars with high yield potentiality is an important one.

There are many genotype(s)/cultivars of ridge gourd which was used in local level in different parts of the country having diverse characters. For most of the improved cultivars, varietal uniformity is one of the main requirements. On the other hand, variability is a desirable goal in germplasm collection, since the material conserved in such collection represents the new material for breeding program. In crop improvement program, genetic diversity is one of the important tools to quantify genetic variability in both cross and self pollinated crops (Gaur *et al.*, 1978). Those genotypes are available in the market without any uniformity and standard nomenclature. Genetic diversity can be expressed as the extent to which heritable material differ within a group of plants (van Hintum, 1995). The diversity of a crop in a plant population is the result of evolution. Alternatively, it is the result of natural selection, spontaneous mutation, dispersion and selection by human beings consciously or subconsciously.

The variability among different genotypes arises either due to geographical separation or due to genetic barriers to crossability. Genetic variability plays an important role in plant breeding because hybrids between lines of diverse origin generally display a great heterosis than those between closely related strains (Singh, 1983) which permits to select the genetically divergent parents to obtain the desirable recombination of the segregating generations. The choice of the most suitable breeding method for the rational improvement of yield and its components in any crop largely depends upon the genetic variability, correlations and association between qualitative and quantitative characters, heritability estimates, and adaptability parameters in different environments. Hence, to formulate a successful breeding program for yield, studies on the association of yield components are very important. The variability available in a population could be partitioned into heritable and non-heritable components with aid of genetic parameters. Improvement in yield and quality of any crop is achieved by selecting genotypes with desirable character combinations that are generally present in the nature or genetic manipulation of diverse parents through hybridization program (Golakia and Maken, 1992).

If a plant breeding program is to be advanced more rapidly and efficiently, knowledge of inter-relationships between yield contributing characters is necessary. Thus, determination of correlation between characters has a considerable importance in selection practices, since it helps in the construction of selection indices and also permits for the prediction of correlated response. The development of an intensive breeding and improvement program needs detailed biological information and an understanding of genetic variation for yield and its components. There must be a thorough knowledge of the existence of genetic variability, the mode of inheritance of economic characters, heritability, the kind of gene action and the relative magnitude of additive, dominance and total genotypic and phenotypic variances of the population.

Considering the above mentioned facts this research work was under taken with the following objectives:

i. To study the morphological characteristics of ridge gourd germplasm;

ii. To study important parameters which will help the breeder for effective selection of genotypes for varietal development;

iii. To find out the best genotype aiming to release as variety(s).

CHAPTER II

REVIEW OF LITERATURE

Ridge gourd is one of the important warm season vegetable grown all over the country of Bangladesh. Its tender fruits are popular and well known for culinary vegetable in our country with good nutritive value and high yield potential. Very few research reports are available on the improvement of this crop have been done in various part of the world including Bangladesh and the work so far done in Bangladesh is not adequate and conclusive. Research effort on genetic variability, character association and path co-efficient analysis seems to be also inadequate and not conclusive. However, some of the important and informative works conducted at home and abroad in this aspect are reviewed below:

2.1 Variability

Genetic variability studies in ridge gourd (*Luffa acutangula*) were undertaken by Gowda (2011) during the year 2010-2011 at Department of Vegetable Science, Karnataka, India. Totally 30 ridge gourd genotypes were evaluated and significant differences were observed among genotypes for all the characters studied. PCV was higher than GCV for all the characters studied. High PCV and GCV were observed for the characters, viz. vine length and number of leaves at 90 DAS, node to first female flower, sex ratio, fruit yield per plant, fruit yield per plot, fruit yield per hectare, average fruit weight, fruit length, number of seeds per fruit and seed yield per fruit indicates maximum variability and offers good scope for improvement by simple selection. High heritability coupled with high genetic advance over per cent of mean was observed for the characters vine length and number of leaves at 90 DAS, node to first female flower, sex ratio, fruit yield per plant, fruit yield per plot, fruit yield per hectare, average fruit weight, fruit length, number of seeds per fruit and seed yield per fruit indicates these characters were governed by additive gene action and offers good scope for improvement by simple selection through these characters.

Fifteen diverse genotypes of ridge gourd were evaluated by Devmore *et al*. (2010) in Dapoli, Maharashtra, India, for their variability, heritability and genetic advance for 15 traits: days to 1st male flower, nodal position for first male flower, days to first female flower, nodal position for first female flower, vine length, primary branches per vine, node number per vine, days to fruit development, days to first fruit harvest, fruit number per vine, fruit length, fruit breadth, fruit weight, 100-seed weight and fruit yield per vine. Based on the nature and magnitude of genetic variability, heritability accompanied with genetic advance as percentage of mean, fruit length, vine length, fruit number per vine, days to first fruit harvest, node number per vine, primary branches per vine would offer scope for selection in breeding for high fruit yield in ridge gourd.

Genetic variability, heritability (h^2), genetic advance were carried out by Choudhary *et al*. (2008) in 22 accession of ridge gourd (*Luffa acutangula*) during rainy season. Highly significant differences between genotypes were recorded for all the characters. Maximum range of mean values was observed for fruit weight followed by yield per plant and fruit length. High degree of variability was observed for fruit weight, yield per plant, fruit length, node at which in female flower appears and fruits per plant. High estimates of heritability in broad sense were obtained for fruit weight and fruit length suggesting hereby both these traits are governed by additive gene action.

A field experiment was conducted by Kumar *et al*. (2007) during summer in Varanasi, Uttar Pradesh, India, with twenty diverse genotypes (VRBG-1, VRBG-2, VRBG-8, VRBG-14, VRBG-18, VRBG-33, VRBG-36, VRBG-37, VRBG-40, VRBG-44, VRBG-48, VRBG-101, VRBG-110, NDBG-56, Pusa-Naveen, Pusa Summer Prolific Long (PSPL), PBOG-61, IC-42345, DVBG-2 and NDBG-58) of ridge gourd. Observations were recorded on 14 characters, i.e. days to 50% germination, days to first male and female flower anthesis, number of branches per vine, vine length, node number of the first male and female flower, days to first fruit harvest, length of edible fruits, number of fruits per vine, individual edible fruit weight, number of seeds per fruit, 100-seed weight and fruit yield per vine. Among all the genotypes, 'VRBG-110', 'NDBG-56', 'VRBG-44', 'PBOG-61', 'Pusa Naveen' and 'VRBG-40' gave promising results.

Five promising F_1 hybrids of ridge gourd involving 7 parents (LA-46, LA-99, LA-12, LA-76, LA-32, LA-37 and LA-17), along with 2 commercial hybrids (Surekha and NS-3), were evaluated by Gautham *et al*. (2004), at Hyderabad, Andhra Pradesh, India. Data were recorded for days to 50% female flowering, node number at which first female flower appeared, number of fruits per vine, fruit weight, length and girth, and yield per vine. Pooled data of 2 years revealed that LA-46 × LA-99 was the earliest to flower. Desirable fruit length and girth were observed in LA-12 × LA-37, LA-12 × LA-17 and LA-12 × LA-76. The highest fruit yield was recorded in LA-12 × LA-37 (1.76 kg/vine), which was at par with LA-12 × LA-76 (1.63 kg/vine). These hybrids recorded 32.5 and 19.5% higher fruit yield over the superior control hybrid NS-3. Genotype × season interaction was significant for node number at which first female flower appeared, fruit weight and girth, and yield per vine, indicating the considerable seasonal effect in the expression of these characters. High estimates of heritability were recorded for fruit length and girth, number of fruits per vine and yield per vine, indicating the possibility of improving these characters through selection.

A diallel analysis was conducted by Hedau and Sirohi (2004a) for 10 *L. acutangula* cultivars/lines (DDRG-1, PRG-6, PRG-7, Pusa Nasdar, DRG-2, CHRG-1, CHRG-2, KRG-5, BRG-3-1 and AAUJ-3) grown in New Delhi, India. Fruit length, fruit weight, fruit diameter and number of fruits per plant were governed by additive and dominant factors. For fruit length and fruit weight, the additive component of genetic variance was more pronounced than the dominant component of the genetic variance. Overdominance was significant for fruit diameter, fruit weight and yield, suggesting that heterosis breeding might be advantageous for greater genetic gain in this species. The narrow-sense heritability was less than 0.5 for number of fruits per plant and fruit yield per plant, indicating the predominance of dominance gene action. Partial dominance and high narrow-sense heritability were recorded for fruit length and weight.

The combining ability for yield and other components in 10 ridge gourd (*Luffa acutangula*) cultivars (DRG-1, PRG-6, PRG-7, Pusa Nasdar, DRG-2, CHRG-1, CHRG-1, KRG-5, BRG-3-1 and AAUJ-3) was investigated by Hedau and Sirohi (2004b) in New Delhi, India. The general combining ability (gca) and the specific combining ability (sca) effects were high and significant for all 7 traits (fruit shape, fruit surface, fruit length, fruit diameter, number of fruits per plant, fruit weight and total yield per plant) indicating that both additive and non-additive gene actions were important in the inheritance of these characters. Pusa Nadar showed the highest positive and significant gca for fruit length, fruit weight and fruit diameter. PRG-6 showed the highest positive and significant gca for fruit number per plant. DRG-1 showed positive gca for total yield per plant. Pusa Nadar was the best general combiner for fruit characters, followed by DRG-1.

Hedau and Sirohi (2004c) estimated heterosis over better and top parents were estimated for 8 traits (vine length, days to first female flower opening, days to first fruit harvest, fruit length, fruit diameter, fruit weight, number of fruits per plant and total yield per plant) in 45 hybrids of ridge gourd (*Luffa acutangula*) during 1999-2001 in New Delhi, India. Fruit characters and fruit yield had positive heterosis, while vine length and flowering showed negative heterosis. The three best performing F_1 hybrids for yield were DRG-1 × P.N., DRG-1 × PRG-7 and DRG-1 × AAUJ-3, which manifested 93.09, 68.51 and 66.50% heterosis over top parent (DRG-1), respectively. These hybrids also recorded the maximum fruit weight, fruit length and highest number of fruits per plant and could be considered for commercial cultivation.

The fruit characteristics of 18 strains and 2 cultivars of *L. acutangula* were evaluated by Shinde *et al*. (2003a) in Parbhani, Maharashtra, India, during the summer season of 1995. The lowest number of days to fruit set was recorded for ‘DPL-RG-12’ (36.99), ‘DPL-RG-4’ (40.33), ‘Punjab Sadabahar’ (40.66) and ‘DPL-RG-2’ (41.00). The average fruit girth was highest in DPL-RG-12 (15.42 cm) and Punjab Sadabahar (14.30 cm). DPL-RG-12 had the highest number of fruits per vine (15.55), whereas Punjab Sadabahar recorded the greatest average fruit length (28.73 cm) and fruit weight (115.33 g). The superior lines in terms of fruit yield and quality were ‘DPL-RG-12’, ‘DPL-RG-2’ and ‘Pusa Sadabahar’.

A field experiment was conducted by Shinde *et al*. (2003b) during 1995 at the Department of Horticulture, Marathwada Agricultural University, Parbhani (Maharashtra, India) to study the growth and yield attributes of 20 ridge gourd (*Luffa acutangula*) genotypes. Tabulated data showed that genotype Punjab Sadabahar recorded significantly highest vine length of 4.80 m. The internodal length (14.57 cm) recorded by ‘DPL-RG-17’ was the highest and significantly more that the remaining 19 treatments. Punjab Sadabahar produced the highest number of leaves per vine (36.55) while DPL-RG-12 recorded the highest number of branches per vine. Punjab Sadabahar produced the highest number of male flowers (59.07) while DPL-RG-12 had the highest number of female flowers (17.33). The lowest sex ratio (male:female) of 2.04 was recorded for DPL-RG-12. The variety Punjab Sadabahar recorded the highest yield with 1.76 kg/vine and 117.33 q/ha.

An experiment was undertaken by Shaha and Kale (2003a) on a set of 45 F1 hybrids obtained from crossing ten lines in half diallel way of ridge gourd (*Luffa acutangula*; P_1 (Atigre), P_2 (Kawalapur), P_3 (Inampangari), P_4 (Panvel), P_5 (RG108), P_6 (Tendoli), P_7 (Jaipur), P_8 (Punjab Sadabahar), P_9 (Co1) and P10 (Pusa Nasdhar)). The 45 F_1 hybrids along with 10 parental lines were grown in summer 1993. The crosses 1×10 (53.2, 24.3), 6×10 (45.3, 83.3) and 3×10 (43.5, 66.1) recorded high heterosis over better parents for weight and number of fruits per vine. The crosses 1×6, 6×8 and 1×3 for fruit weight per vine recorded significant heterobeltiosis. The crosses 2×6 and 9×10 for fruit diameter, 1×8, 8×9, 1×2, 4×6 and 2×9 for average fruit weight, 1×3, 3×10 and 1×10 for vine length recorded significant and/or magnitudinally high heterobeltiosis. The crosses 1×10, 6×10, 3×10 were the best as they exhibited significant heterobeltiosis for weight (yield) and fruit number per vine. The crosses 2×6 and 9×10 for fruit diameter, 1×8, 8×9, 1×2, 4×6 and 2×9 for average fruit weight and 1×3 for vine length recorded significant heterobeltiosis.

Forty-five hybrids of ridge gourd (*Luffa acutangula*) developed using ten parents (Atigre, Kawalapur, Inampangari, Panvel, RG-108, Tendoli, Jaipur, Punjab Sadabahar, Co1 and Pusa Nasdhar) in half diallel were studied by Shaha and Kale (2003b) for combining ability. The analysis of variance for combining ability showed that the mean sum of squares due to general combining ability (GCA) and specific combining ability (SCA) were significant for all the characters, indicating the presence of variation in combining abilities of the parents used. The GCA mean squares were higher than those for SCA in all the characters. The parents Co1, Panvel and Inampangari were the best general combiners for yield and yield components. Parents with the high per se performance also exhibited high GCA effects. The hybrids Atigre × Pusa Nasdhar and Atigre × Tendoli were the best as they produced significantly high SCA effects for weight and number of fruits per vine, days to first harvest, average fruit weight, vine length, position of first female flower and number of female flowers per vine which can be exploited directly for yield heterosis. The other crosses Kawalapur × RG-108, Tendoli × Punjab Sadabahar, Jaipur × Co1 and Inampangari x RG-108 had significant SCA effects for earliness.

The mechanism of gene action involved in the inheritance of yield and yield components in 45 ridge gourd hybrids (*L. acutangula*) was determined by Tyagi *et al*. (2003) in a field experiment conducted in Rajasthan, India. Both general (GCA) and specific combining ability (SCA) were influenced by the environment. Additive gene effects were predominant for vine length, number of days to first male flower opening, number of male and female flowers per plant, sex ratio, number of nodes per plant, number of fruits per plant, fruit length, fruit girth, fruit yield and number of seeds per fruit, whereas non-additive gene effects were predominant for number of days before first female flower opening and maturity of the fruit. The parent P_8 was the best combiner for fruit yield. Most of the crosses exhibiting higher SCA effects involved both or one good and another medium or negative combiner.

An experiment was conducted by Singh *et al*. (2002) on 80 ridge gourd genotypes to determine the genetic variability and heritability. High phenotypic coefficient of variation (pcv) and genetic coefficient of variation (gcv) were observed for node number for appearance of first male flower, male flowers per plant, sex ratio on whole plant, main axis and branches, fruits per plant, fruit weight, seeds per fruit and yield per plant. The gcv and pcv values were almost equal for most of the characters studied. The broad sense heritability estimates were high for all the characters. High heritability with high genetic advance was observed for number of nodes for appearance of first male and female flower, length of main axis, number of primary branches, male and female flowers per plant, sex ratio on the whole plant, main axis and branches, fruits per plant, fruit set, fruit length, fruit weight, seeds per fruit, 100-seed weight and yield per plant.

Genetic variation, heritability and genetic advance for yield and yield components were studied by Chowdhury and Sarma (2002) in 12 *L. acutangula* cultivars (AAUJ-1, AAUJ-2, AAUJ-3, Mangaldoi, Tezpeu, Tihu, Mirza Short, Rangamati Long, Borpeta Long, Tiniali Long, Pusa Nazder, and HRS C-2) grown in Gwuahati, Assam, India. The genetic coefficient of variation (GCV) was higher than the phenotypic coefficient of variation (PCV) for all characters. High values of heritability, PCV, GCV, and genetic advance were recorded for vine length, yield per hectare, and fruit weight, indicating that these traits were characterized by additive gene effects.

A field experiment was conducted by Jawadagi *et al.* (2002) in Gangavati, Dharwad, Karnataka, India, to evaluate ten *L. accutangula* cultivars (Ittnalli local-1, Ittnalli local-2, Poona local, Jumnal local, Pusa Nasdar, Raichur local-2, Deodurga local, Kotiyal local, Malapur-2, and Japanese Long) for resistance to natural salinity gradient of 4, 6, 8, and 10 ds/m. Yield reduction increased with the increase in soil salinity. Among the cultivars, Kotiyal local had the highest yield under a soil salinity gradient of up to 8 ds/m. The cultivars were grouped based on genetic diversity under various salinity levels. The high-yielding cultivars Kotiyal local, Malapur-2, and Japanese Long were grouped under the first category. The second category was marked by lower maximum yield but lower yield reduction (Ittnalli local-1, Poona local, and Pusa Nasdar). Ittnalli local-2, Jumnal local, Raichur local-2, and Deodurga local, grouped under the third category, were characterized by lower yield potential and high yield reduction.

Manifestation of heterosis for yield and its components was investigated by Rao and Rao (2002) in 28 F_1 hybrids of ridge gourd obtained from a diallel set involving eight parents (excluding reciprocals). Appreciable significant heterosis was recorded over the respective parental lines for days to first male flower appearance, yield per vine, weight and volume of the fruit. For yield the F_1 LA-46 × LA-99, LA-12 × LA-76 and LA-32 × LA-37 proved the best and manifested 51.8 and 125.9, 81.8 and 121.1 and 99.1 and 200.1% heterosis, respectively, in both kharif and summer seasons over the better parent. The F_1 hybrid LA-46 × LA-99 which produced large-sized fruits consistently over the seasons was identified as the best for number of fruits and yield per vine.

L. acutangula hybrids and parental lines (LA 81, LA 43, LA 44, LA 87, and LA 86) were evaluated by Mole (2001) for heterosis and combining ability for yield and yield components. LA 44 was the best general combiner for earliness and number of primary branches. LA 44 × LA 87 showed the highest specific combining ability (sca) effect for days to first harvest, whereas LA 81 × LA 44 exhibited the highest sca effect for number of fruits, yield per plant, and fruit girth. For average fruit weight and fruit length, LA 86 exhibited the greatest general combining ability (gca) effect, whereas LA 87 × LA 86 showed the highest sca effect. LA 81 had the greatest gca effect for fruit girth. The importance of non-additive genetic components and the dominance of genetic action were evident. Standard heterosis was very low in all crosses High positive heterosis for fruit girth over better parent and standard parent was recorded for LA 81 × LA 44. High heterosis over standard parent for vine length and days to first harvest was observed in LA 44 × LA 87. Hybrids with at least one of the superior lines (LA 87, LA 81, and LA 44) as parent showed a strong tendency to produce high yields.

Half diallel studies for combining ability and heterosis were conducted by Shaha and Kale (2001) in Maharashtra, India on 45 ridge gourd (*Luffa acutangula*) hybrids resulting from crossing 10 parents (Atigre, Kawalapur, Inampangari, Panvel, RG 108, Tendoli, Jaipur, Sadabahar, Punjab and PusaNasdhar). Punjab was observed to be one of the best general combiners, as it exhibited good combining ability for yield and yield-contributing characters (number of branches per vine, vine length, internodal length, days to first female flower, fruit length, and number and weight of fruits per vine). Inampangari and Panvel were also good general combiners for yield, earliness, vine and fruit characters. Besides good general combining ability effects, they had high per se performance which will help in identifying good general combiners. Atigre × PusaNasdhar and Atigre × Tendoli appeared to be the best, as these produced significantly high specific combining ability (sca) effects for all yield-contributing characters, indicating the possibility of exploiting these crosses. Crosses producing high sca effects for various characters exhibited high heterobeltiosis and high per se performance and vice-versa, except for days to first female flower. This may help in predicting the performance of a specific cross based on either of the components alone. These crosses involved the parents with good × good, good × poor or poor × poor combining ability, suggesting the presence of additive and nonadditive gene action.

Twenty-eight F_1 crosses of ridge gourd (*L. acutangula*) in a diallel set involving 8 parents (excluding reciprocals) were evaluated by Rao *et al*. (2000) during the kharif season, in Hyderabad, India, to study heterosis for node to first male flower, node to first female flower, node to first fruit, number of fruits per vine, branches per vine, fruits per branch, length of the vine and yield per vine. Appreciable significant heterosis was recorded over the better parental lines consistently over the seasons for all the characters except node to first female flower and node to first fruit. The three best performing F_1 hybrids LA-46 × LA-99, LA-12 × LA-76 and LA-32 × LA-37 also showed 51.8 and 125.9, 81.8 and 121.1 and 99.1 and 200.1% higher yield over the better parent in kharif and summer seasons, respectively. The high yield recorded in these hybrids has been directly attributed to increased number of fruits per vine and fruits per branch. The best F1 hybrid LA-46 × LA-99 which gave 51.8 and 125.9% higher yield over the better parent and top parent, respectively, was attributed to increased number of fruits per vine, fruit per branch and medium vines.

A half diallel of ten parents of ridge gourd (*Luffa acutangula*) was evaluated by Shaha *et al*. (1999) to identify good combiners and best combinations along with its heterotic effects. The variance for GCA and SCA were significant for all the characters except number of branches/vine indicated variation in combining ability of parents. Parent P_9 (CO1) appeared to be one of the best general combiners for weight of fruits, number of fruits, days to 50% harvest and days to first female flower. Whereas P_3 (Inampangari), P_4 (Panvel), P_6 (Tendoli) were also good general combiners for yield, earliness, vine and fruit characters. Along with good general combining ability effects, they had high per se performance suggesting the importance of per se performance in predicting the combining ability. The combination 1 × 10, 3 × 10, 5 × 9, and 6 × 10 exhibited significantly high SCA effects. These crosses involved the parents either good × good, good × poor/poor × good or poor × poor combining ability indicating the presence of higher order interaction for yield as well as its component characters suggesting the role of non-allelic genes in the expression of these characters.

2.2 Characters association

Genetic variability studies in ridge gourd (*Luffa acutangula*) were undertaken by Gowda (2011) during the year 2010-2011 at Department of Vegetable Science, Karnataka, India. Totally 30 ridge gourd genotypes were evaluated and significant differences were observed among genotypes for all the characters studied. The character association studies revealed that the fruit yield per plant highly significant and positive association with vine length 45 and 90 DAS, number of branches 90 days after sowing, number of leaves at 45 and 90 DAS, days to last harvest, sex ratio, per cent fruit set, number of fruits per plant, fruit yield per plot, fruit yield per hectare, fruit length, fruit diameter, rind thickness, flesh thickness, number of seeds per fruit, seed yield per fruit, 100 seed weight. Since, these association characters are in the desirable direction, selection for these traits will improve the yield per plant. Path co-efficient analysis revealed that number of fruits per plant and average fruit weight had high direct effect on fruit yield per plant. The genotypes Arka Sumeet, Arka Sujat and Jaipur Long were superior genotypes for fruit size, quality and yield parameters. Selection of superior genotypes involves crossing and making selection in segregating generations.

Character association and path analysis were carried out by Choudhary *et al*. (2008) in 22 accession of ridge gourd (*Luffa acutangula*) during rainy season. Positive and significant association of yield per plant was observed with fruit length and fruit weight at both genotypic and phenotypic level indicating that selection based on these characters either in combination or alone will result in identifying the genotypes having high yield potential. The average fruit weight, fruits per plant and days taken to initiation of female flower had maximum direct effect on yield followed by number of primary branches per plant. Therefore, fruit weight, fruits per plant, days taken to initiation of in female flower and number of primary branches per plant should be considered as selection criteria for yield improvement in ridge gourd breeding.

The correlation between the yield and yield components of ridge gourd (*Luffa acutangula*) was studied by Prasanna *et al*. (2002) in Bangalore, Karnataka, India, during the rabi. Fruit yield per hectare was positively associated with vine length at 90 days after sowing (DAS), number of leaves at 90 DAS, number of female flowers, total dry weight of plant, number of fruits, and fruit girth and weight. Path coefficient analysis showed that vine length at 90 DAS, number of female flowers per vine, number of branches per vine, number of fruits per vine, fruit girth, and fruit weight had direct positive effects on fruit yield, whereas the number of leaves at 90 DAS, total dry weight of the plant, and fruit length had negative direct effects on fruit yield. The fruit yield of ridge gourd can be enhanced through the improvement of vine length at 90 DAS, number of female flowers, number of branches, number of fruits per vine, fruit girth, and fruit weight.

Correlation coefficient analysis of yield components was conducted by Shah and Kale (2002) on 55 genotypes (10 parents and 45 hybrids) of ridge gourd (*Luffa acutangula*). The fruit weight per vine was positively and significantly correlated with the fruit number per vine, average fruit weight, number of female flowers per vine and vine length, indicating the close association and dependency of yield on these characters. The fruit length was negatively correlated with fruit diameter and fruit number per vine, while it was positively correlated with the average fruit weight. Significant correlations were found in the following characters: fruit number per vine with number of female flowers per vine; branch number with vine length, internodal length and number of male flowers per vine; internodal length with average fruit weight. It is concluded that fruit number per vine, number of female flowers per vine, vine length and average fruit weight could be considered while selecting for high yielding ridge gourd genotypes.

Correlation for yield and yield components were studied by Chowdhury and Sarma (2002) with 12 *L. acutangula* cultivars (AAUJ-1, AAUJ-2, AAUJ-3, Mangaldoi, Tezpeu, Tihu, Mirza Short, Rangamati Long, Borpeta Long, Tiniali Long, Pusa Nazder, and HRS C-2) in Gwuahati, Assam, India. The correlation coefficients revealed that yield per hectare can be improved through selection for greater fruit number per plant, fruit length and girth, and individual fruit weight.

Correlation and path coefficient analysis were conducted by Rao *et al*. (2000) in the segregating population of ridge gourd. The magnitude of genotypic correlation coefficient was higher than the phenotypic coefficients indicating strong inherent association among the various characters studied. Yield per vine exhibited significant positive correlation with volume of fruit, fruits per vine, fruits per branch and length of the vine at both phenotypic and genotypic levels while girth and weight of fruit at genotypic level only. Days to first male and female flower and days to 50% flowering exhibited significant negative correlation with yield per vine and fruits per vine indicating early appearance of male and female flowers were a prerequisite of more number of fruits and higher yield per vine. Path analysis revealed that yield improvement could be achieved by direct selection for days to 50% flowering, girth of fruit, fruits per vine, fruits per branch and length of the vine in ridge gourd.

Correlation and path-coefficient analyses were conducted by Rao *et al*. (1999) in 36 genotypes of ridge gourd. The majority of genotypic correlation coefficients were higher than phenotypic correlation coefficients, indicating a strong inherent association among various characters studied. Yield per vine was significantly and positively correlated with number of fruits per vine, fruits per branch, girth, weight and volume of the fruit, but was negatively correlated with days to first female flower. Path coefficient analysis confirmed that number of fruits per vine, weight of the fruit and days to first female flower were the major yield components having high direct effect on yield per vine.

The above cited review revealed that the importance of a systematic research on ridge gourd genotypes in genetic diversity, correlation among yield contributing characters, path co-efficients patents and gene actions of governing characters for improvement of the crop.

CHAPTER III

MATERIALS AND METHODS

The experiment was carried out during the period from April to August 2012 to study variability character association and path co-efficient analysis of ridge gourd. The materials and methods that were used for conducting the experiment have been presented in this chapter. It includes a short description of the location of experimental site, climate and soil condition of the experimental plot, materials used for the experiment, design of the experiment, data collection procedure and procedure of data analysis.

3.1 Experimental site

The experiment was conducted at the Regional Horticulture Research Station, Mojlishpur, Shibpur, Narsingdi. The location of the experimental site was situated between $23^0 56^/$ and $24^0 56^/$ North latitude, and $90^0 38^/$ and $90^0 50^/$ East longitude and at an elevation of 8.2 m from sea level.

3.2 Characteristics of soil

The soil of the experimental area belongs to the Modhupur Tract (UNDP, 1988) under AEZ No. 28 (Appendix I). It had shallow red brown terrace soil. The selected plot was medium high land and the soil series was Kalma (FAO, 1988). Details morphological, physical and chemical properties are presented in Appendix II.

3.3 Climatic condition

The climate of experimental site was under the subtropical climate, characterized by three distinct seasons, winter season from November to February and the pre-monsoon or hot season from March to April and the monsoon period from May to October (Edris *et al.*, 1979). Details of the meteorological data during the period of the experiment was collected from the Weather Station, Agargaon and presented in Appendix III.

3.4 Planting materials

In this experiment 10 germplasm were used as test crop. Of these 9 germplasm obtained from ridge gourd breeding program, Olericulture Division, Horticulture Research Centre (HRC), BARI. One local germplasm was collected from Narsingdi bazar. Each of the germplasm was produced in the 2010-2011 cropping season. Name of the germplasm presented below-

Table 1. Name of ridge gourd germplasm used in the present study

Sl. #	Ridge gourd germplasm	Sl. #	Ridge gourd germplasm
01	LA-201	06	LA-212
02	LA-206	07	LA-214
03	LA-208	08	LA-216
04	LA-210	09	LA-217
05	LA-211	10	Local variety

3.5 Land preparation

The plot selected for conducting the experiment was opened in the last week of March, 2012 with a power tiller, and left exposed to the sun for a week. After one week the land was harrowed, ploughed and cross-ploughed several times followed by laddering to obtain good tilth. Weeds and stubbles were removed and finally obtained a desirable tilth of soil for sowing ridge gourd seeds. The soil was treated with insecticides (Cinocarb 3G @ 4 kg/ha) at the time of final land preparation to protect young plants from the attack of soil inhibiting insects such as cutworm and mole cricket. Pit was prepared for seed sowing after final land preparation.

3.6 Design and layout of the experiment

The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The total area of the experimental plot was 474.5 m^2 with length 36.5 m and width 13.0 m. The total area was divided into three equal blocks. Each block was divided into 10 plots where 10 ridge gourd germplasam were allotted at random. There were 30 unit plots altogether in the experiment. The size of the each plot was 3.0 m × 3.0 m and there were 4 pit in each plot. The distance maintained between two blocks and two plots were 1.0 m and 0.5 m, respectively. The layout of the experiment is shown in Figure 1.

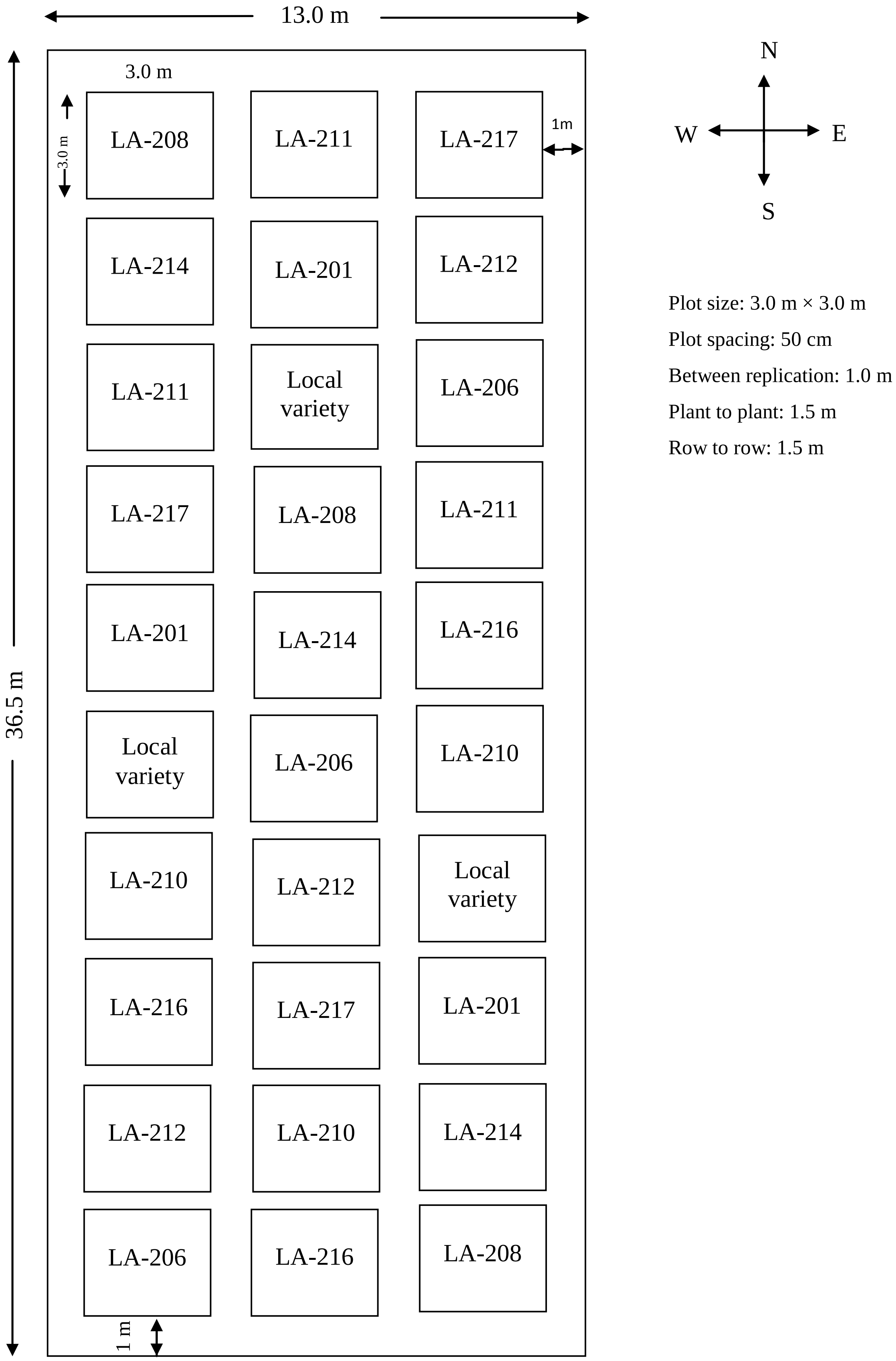


Figure 1. Layout of the experimental plot

3.7 Application of manure and fertilizers

Urea, Triple Super Phosphate (TSP) and Muriate of Potash (MP) were used as a source of nitrogen, phosphorous, and potassium, respectively. Manures and fertilizers that were applied to the experimental plot according to Fertilizer Recommendation Guide (2005) and presented in Table 2. According this 750 g cowdung, 23 g urea, 10 g TSP, 18 g MP, 5 g gypsum and 0.5 g boron was applied in each pit. The total amount of cowdung, TSP and MP were applied as basal dose at the time of final land preparation dated. Urea was applied at 30, 60 and 90 days after sowing (DAS) of seeds.

Table 2. Dose and method of application of fertilizers in ridge gourd field

Fertilizers	Dose/ha	Application (%)			
		Basal	30 DAS	60 DAS	90 DAS
Cowdung	5 tons	100	--	--	--
Nitrogen (as urea)	100 kg	--	33.33	33.33	33.33
P_2O_5 (as TSP)	45 kg	100	--	--	--
K_2O (as MP)	80 kg	100	--	--	--
S (as gypsum)	25 kg	100	--	--	--
B (as borax)	2.0 kg	100	--	--	--

3.8 Seeds sowing

The seeds of ridge gourd were sown in the main field at 04 April in 2012. Seeds were treated with Bavistin before sowing to control the seed borne diseases. Total 3 seeds were sown in each pit having a depth of 2-3 cm with maintaining distance from 1.5 m and 1.5 m from row to row and plant to plant, respectively.

3.9 Intercultural operation

After raising seedlings, various intercultural operations such as gap filling by healthy seedlings, weeding, earthing up, irrigation pest and disease control etc. were accomplished for better growth and development of the ridge gourd seedlings.

3.9.1 Thinning and support for plants

The seedlings in the experimental plot were kept under careful observation. Very few seedlings were damaged after germination. Comparatively weak seedlings were removed from pit leaving only one plant in each pit. As a climbing plant staking was made by bamboo stick for support and and easy development of plant.

3.9.2 Weeding

Weeding was done 30, 60 and 90 days after sowing to keep the plots free from weeds.

3.9.3 Irrigation

Light watering was given by a watering cane at every morning and afternoon and it was continued for a week for rapid and well establishment of the germinated seedlings.

3.9.4 Pest and disease control

Insect infestation was a serious problem during the period of establishment of seeding in the field. In spite of Cirocarb 3G applications during final land preparation few young plants were damaged due to attack of mole cricket and cut worm. Pumpkin beetle were controlled both mechanically and spraying Carbarin 85 WP 2g/L. Some discolored and yellowish diseased leaves were also collected from the plant and removed from the field.

3.10 Harvesting

Fruits were harvested based on the attaining of eating quality. Harvesting was started from June, 2012 and was continued up to August, 2012.

3.11 Data collection

Three plants were randomly selected from each unit plot for data recording. Data were collected in respect of the following parameters to assess plant growth; yield attributes and yields as influenced by different treatments of the experiment.

3.11.1 Days to 1^{st} flowering

Difference between the dates of sowing to the date of 1^{st} flowering of a plot and counted as days to 1^{st} flowering. Days to 1^{st} flowering was counted when plants of a plot produced 1^{st} flower.

3.11.2 Days to 1^{st} harvest

Difference between the dates of sowing to the date of 1^{st} harvest of a plot and counted as days to 1^{st} harvest. Days to 1^{st} harvest was counted when plants of a plot produced 1^{st} marketable fruit.

3.11.3 Fruit length

The length of fruit was measured with a meter scale from the neck of the fruit to the bottom of 10 selected marketable fruits from each plot and there average was taken and expressed in cm.

3.11.4 Fruit diameter

Diameter of fruit was measured at the middle portion of 10 selected marketable fruit from each plot with a digital calipers-515 (DC-515) and average was taken and expressed in cm.

3.11.5 Individual fruit weight

The weight of individual fruit was measured with a digital weighing machine from 10 selected marketable fruits from each selected plots and there average was taken and expressed in gram.

3.11.6 Number of fruits per plant

The number of fruits per plant was counted from the sample plants for the whole growing period and the average number of fruits produced per plant was recorded and expressed in fruits per plant.

3.11.7 Fruit yield per plant

Fruit yield of ridge gourd was recorded as the whole fruit per plant by weighing a digital machine for the whole growing period and was expressed in gram.

3.11.8 Weight of 100 seeds

One hundred seeds were counted randomly from the total cleaned harvested seeds of each individual plot and then weighed and recorded in grams.

3.11.9 Fruit yield per plot

Fruit yield of ridge gourd was recorded as the whole plot by weighing a digital balance for the whole growing period and was expressed in kg.

3.11.10 Fruit yield per hectare

Fruit yield per hectare of ridge gourd was estimated by converting the weight of plot yield into hectare and was expressed in ton.

3.12 Statistical analysis

The data obtained for different characters were statistically analyzed by using MSTAT-C software. The mean values of all the recorded characters were evaluated and analysis of variance was performed by the 'F' (variance ratio) test. The significance of the difference among the means of treatment combinations was estimated by Duncan's Multiple Range Test (DMRT) at 5% level of probability (Gomez and Gomez, 1984).

3.13 Estimation of variability

Genotypic and phenotypic coefficient of variation and heritability were estimated by using the following formulae:

3.13.1 Estimation of components of variance from individual environment

Genotypic and phenotypic variances were estimated with the help of the following formula suggested by Johnson *et al*. (1955). The genotypic variance (σ^2_g) was estimated by subtracting error mean square (σ^2_e) from the genotypic mean square and dividing it by the number of replication (r) as per following formula -

$$\text{Genotypic variance } (\sigma^2_g) = \frac{MS_V - MS_E}{r}$$

Where,

MS_V = genotype mean square

MS_E = error mean square

r = number of replication

The phenotypic variance (σ^2_p), was derived by adding genotypic variances with the error variance, as given by the following formula –

Phenotypic variance (σ^2_{ph}) = $\sigma^2_g + \sigma^2_e$

Where,

σ^2_{ph} = phenotypic variance

σ^2_g = genotypic variance

σ^2_e = error variance

3.13.2 Estimation of genotypic co-efficient of variation (GCV) and phenotypic co-efficient of variation (PCV)

Genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were calculated following formula as suggested by Burton (1952):

$$\% \text{ Genotypic coefficient of variance} = \frac{\sigma_g}{\bar{x}} \times 100$$

Where,

σ_g = genotypic standard deviation; $\bar{x}$ = population mean

$$\% \text{ Phenotypic coefficient of variance} = \frac{\sigma_{ph}}{\bar{x}} \times 100$$

Where,

σ_{ph} = phenotypic standard deviation; $\bar{x}$ = population mean

3.13.3 Estimation of heritability

Heritability in broad sense was estimated following the formula as suggested by Johnson *et al*. (1955):

$$\text{Heritability (\%)} = \frac{\sigma^2_g}{\sigma^2_{ph}} \times 100$$

Where,

σ^2_g = genotypic variance and σ^2_{ph} = phenotypic variance

3.13.4 Estimation of genetic Advance

The following formula was used to estimate the expected genetic advance for different characters under selection as suggested by Allard (1960):

$$GA = \frac{\sigma^2_g}{\sigma^2_p} \times K.\ \sigma_{ph}$$

Where,

GA = Genetic advance

σ^2_g = genotypic variance

σ^2_{ph} = phenotypic variance

σ_{ph} = phenotypic standard deviation

K = Selection differential which is equal to 2.64 at 5% selection intensity

3.13.5 Estimation of Genetic Advance in percentage of mean

Genetic advance in percentage of mean was calculated by the following formula given by Comstock and Robinson (1952):

$$\text{Genetic Advance in percentage of mean} = \frac{\text{Genetic advance}}{\bar{x}} \times 100$$

3.14 Estimation of correlation

Simple correlation was estimated for different traits with the following formula (Singh and Chaudhary, 1985):

$$r = \frac{\sum xy - \dfrac{\sum x.\ \sum y}{N}}{[\{\sum x^2 - \dfrac{(\sum x)^2}{N}\}\{\sum y^2 - \dfrac{(\sum y)^2}{N}\}]^{1/2}}$$

Where,

$\sum$ = Summation

x and y are the two variables

N = Number of observations

3.15 Path co-efficient analysis

Path co-efficient analysis was done according to the procedure employed by Dewey and Lu (1959) also quoted in Singh and Chaudhary (1985), using simple correlation values. In path analysis, correlation co-efficient is partitioned into direct and indirect of independent variables on the dependent variable.

In order to estimate direct and indirect effect of the correlated characters, say x_1, x_2, x_3 yield y, a set of simultaneous equations (three equations in this example) is required to be formulated as given below:

$$ryx_1 = Pyx_1 + Pyx_2rx_1x_2 + Pyx_3rx_1x_3$$

$$ryx_2 = Pyx_1rx_1x_2 + Pyx_2 + Pyx_3rx_2x_3$$

$$ryx_3 = Pyx_1rx_1x_3 + Pyx_2\,rx_2x_3 + Pyx_3$$

Where, r's denotes simple correlation co-efficient and P's denote path co-efficient (unknown). P's in the above equations may be conveniently solved by arranging them in matrix form. Total correlation, say between x_1 and y is thus partitioned as follows:

Pyx_1 = The direct effect of x_1 on y

$Pyx_1rx_1x_2$ = The indirect effect of x_1 via x_2 on y

$Pyx_1rx_1x_3$ = The indirect effect of x_1 via x_3 on y

After calculating the direct and indirect effect of the characters, residual effect (R) was calculated by using the formula given below (Singh and Chaudhary, 1985):

$$P^2RY = 1 - \sum Piy.riy$$

Where,

$P^2RY = (R^2)$; and hence residual effect, $R = (P^2RY)^{1/2}$

Piy = Direct effect of the character on yield

riy = Correlation of the character with yield

CHAPTER IV

RESULTS AND DISCUSSION

The present experiment was conducted to study the variability character association and path co-efficient analysis of ridge gourd. The analyses of variance (ANOVA) of different yield contributing characters and yield of ridge gourd have been presented in Appendix IV. The results have been discussed and possible interpretations are given under the following headings:

4.1 Morphological characteristics

Different morphological characteristics were studied on the ridge gourd germplasm LA-201, LA-206, LA-208, LA-210, LA-211, LA-212, LA-214, LA-216, LA-217 and Local variety and the observations were presented in Table 3. In consideration of flower colour, it was observed that the flowers of each germplasms were yellow in colour. Blossom end fruit shape of LA-212 was depressed, LA-216 rounded, LA-217 flattened and other germplasm were pointed (Plate 1). Stem end fruit shape of LA-212 was flattened and LA-217 was rounded and other germplasm was pointed. The germplasms LA-201, LA-208, LA-211, LA-214, LA-216 and Local variety had elongated tapped fruit shape, whereas elliptical fruit was observed in LA-206, elongate slim for LA-210, pyriform for LA-212 and elongate elliptical for LA-217. Intensity of ribs was intermediate for LA-208, LA-211, LA-212, LA-216 and LA-217 and Local variety, whereas, LA-201 & LA-210 and LA-206 & LA-214 were prominent and superficial, respectively. Fruit colour of the germplasm LA-206, LA-211, LA-212, LA-214 was green, while LA-210, LA-216, LA-217 and local variety had light green, whereas, LA-201 and LA-208 were deep green in fruit colour. Among the germplasm, high fruit uniformity was found for LA-208, LA-210, LA-211, LA-212, and LA-217, whereas, medium fruit uniformity was recorded for LA-201, LA-206, LA-214, LA-217 and for Local variety fruit uniformity was medium.

Table 3. Morphological characteristics of different ridge gourd germplasm

Germplasm	Flower color	Blossom end fruit shape	Stem end fruit shape	Fruit shape	Intensity of ribs	Fruit color	Fruit uniformity
LA-201	Yellow	Pointed	Pointed	Elongate tapered	Prominent	Deep green	Medium
LA-206	Yellow	Pointed	Pointed	Elliptical	Superficial	Green	Medium
LA-208	Yellow	Pointed	Pointed	Elongate tapered	Intermediate	Deep green	High
LA-210	Yellow	Pointed	Pointed	Elongate slim	Prominent	Light green	High
LA-211	Yellow	Pointed	Pointed	Elongate tapered	Intermediate	Green	High
LA-212	Yellow	Depressed	Flattened	Pyriform	Intermediate	Green	High
LA-214	Yellow	Pointed	Pointed	Elongate tapered	Superficial	Green	Medium
LA-216	Yellow	Rounded	Pointed	Elongate tapered	Intermediate	Light green	Medium
LA-217	Yellow	Flattened	Rounded	Elongate elliptical	Intermediate	Light green	High
Local variety	Yellow	Pointed	Pointed	Elongate tapered	Intermediate	Light green	Medium

4.2 Yield contributing characters and yield

4.2.1 Days to 1st flowering

Different germplasm varied significantly for days to 1st flowering of ridge gourd (Table 4). The maximum days to 1st flowering (48.00) was observed in LA-210 and LA-211 which was statistically similar with other germplasm except Local variety and LA-206, the minimum days (39.67) in Local variety. The average days to 1st flowering was recorded 45.93.

4.2.2 Days to 1st harvest

Statistically significant variation was recorded for different germplasm for days to 1st harvest of ridge gourd (Table 4). The average days to 1st harvest was recorded 62.00. The maximum days to 1st harvest (69.67) in Local variety and the minimum days (57.00) was found in LA-211.

4.2.3 Fruit length

Fruit length of ridge gourd varied significantly due to different germplasm (Table 4). The longest fruit (26.32 cm) was recorded in LA-201 and the shortest fruit (17.60 cm) was observed in LA-206 germplasm. The average fruit length was found to be 21.26 cm. Shinde *et al*. (2003a) reported that Punjab Sadabahar recorded the greatest average fruit length (28.73 cm).

4.2.4 Fruit diameter

Fruit diameter was significantly different among the ridge gourd germplasm (Table 4). The highest fruit diameter (4.21 cm) was recorded from the germplasm LA-217 which was closely followed (3.88 cm and 3.87) by LA-214 and LA-211, while the lowest fruit diameter (3.29 cm) was produced by LA-210 germplasm. The average fruit length was recorded to be 3.62 cm.

4.2.5 Individual fruit weight

Significant differences were recorded among different germplasm for individual fruit weight of ridge gourd (Table 4). The highest individual weight of fruit weight (137.55 g) was obtained in LA-211 and the lowest weight (73.55 g) in LA-208. The average weight of individual fruit was 98.80 g. Shinde *et al*. (2003a) reported that Punjab Sadabahar produced highest fruit weight (115.33 g).

Table 4. Mean performance of ridge gourd germplasm in respect of quantitative characters (cont'd)

Germplasm	Days to 1st flowering	Days to 1st harvest	Fruit length (cm)	Fruit diameter (cm)	Individual fruit weight (g)
LA-201	47.67 a	64.67 ab	26.32 a	3.46 cd	109.00 b
LA-206	43.00 ab	60.00 bc	17.60 d	3.49 cd	85.35 cd
LA-208	48.00 a	62.00 bc	19.00 cd	3.34 cd	73.55 d
LA-210	48.00 a	62.00 bc	24.76 a	3.29 d	90.85 bcd
LA-211	40.00 b	57.00 c	24.72 a	3.87 ab	137.55 a
LA-212	44.67 a	62.00 bc	19.54 bcd	3.70 bc	90.45 bcd
LA-214	46.67 a	61.00 bc	21.23 b	3.88 ab	103.70 bc
LA-216	46.67 a	64.67 ab	20.77 bc	3.50 bcd	85.90 cd
LA-217	47.00 a	57.00 c	18.57 cd	4.21 a	128.30 a
Local variety	39.67 b	69.67 a	20.07 bc	3.49 cd	083.35 cd
$LSD_{(0.05)}$	4.744	6.626	1.998	0.352	18.62
Level of significance	*	*	**	**	**
CV(%)	6.02	6.23	5.48	5.68	10.99

Means followed by same letter(s) in a column did not differ significantly

**: Significant at 0.01 level of probability; *: Significant at 0.05 level of probability

Table 4. Mean performance of ridge gourd germplasm in respect of quantitative characters

Germplasm	Number of fruits/plant	Fruit yield/plant (kg)	Fruit yield/plot (kg)	Weight of 100 seeds (g)	Fruit yield/hectare (ton)
LA-201	24.50 abc	2.70 b	10.79 b	10.75 bc	11.99 b
LA-206	30.50 abc	2.63 b	10.51 b	11.50 b	11.68 b
LA-208	38.15 a	2.80 b	11.14 b	8.35 de	12.38 b
LA-210	20.30 bc	1.81 d	7.24 c	8.75 cde	8.04 c
LA-211	36.75 ab	5.04 a	20.17 a	10.15 bcd	22.41 a
LA-212	33.63 ab	2.40 bc	11.58 b	9.00 cde	12.87 b
LA-214	26.25 abc	2.66 b	10.64 b	11.75 b	11.82 b
LA-216	22.05 abc	1.90 d	7.59 c	15.00 a	8.43 c
LA-217	16.00 c	2.07 cd	8.29 c	9.00 cde	9.21 c
Local variety	24.00 abc	1.97 cd	7.89 c	7.80 e	8.77 c
$LSD_{(0.05)}$	15.07	0.434	1.285	1.991	1.427
Level of significance	**	**	**	**	**
CV(%)	10.21	9.75	7.08	11.37	7.08

Means followed by same letter(s) in a column did not differ significantly

**: Significant at 0.01 level of probability

4.2.6 Number of fruits/plant

Different germplasm varied significantly in terms of number of fruits/plant of ridge gourd (Table 4). The maximum number of fruits/plant (38.15) was observed in LA-208 and the minimum number (16.00) was observed in LA-217 germplasm. The average number of fruits/plant was found 27.21.

4.2.7 Fruit yield/plant

Fruit yield/plant was found significantly different among the germplasm (Table 4). The average fruit yield/plant was found 2.60 kg. The highest fruit yield/plant (5.04 kg) was found in LA-211 which was significantly different from all other genotypes. The second highest fruit yield/plant (2.80 kg) was for the germplasm of LA-208 which was followed (2.70 kg) by LA-210. The lowest yield/plant (1.81 kg) was found in LA-210 germplasm. Shinde *et al*. (2003b) recorded the highest yield with 1.76 kg/vine.

4.2.8 Fruit yield/plot

Statistically significant variation was recorded for different germplasm in regards to fruit yield/plot of ridge gourd (Table 4). The highest fruit yield/plot (20.17 kg) was recorded in LA-211 and the lowest yield/plot (7.24 kg) was found in LA-210 germplasm. The average fruit yield/plot was recorded 10.58 kg.

4.2.9 Weight of 100 seeds

Weight of 100 seeds of ridge gourd varied significantly due to different germplasm (Table 4). The average weight of 100 seeds was recorded to be 10.21 g and the highest weight of 100 seeds (15.00 g) was attained in LA-216 and the lowest weight (7.80 g) was observed in Local variety.

4.2.10 Fruit yield/hectare

The germplasm were statistically significant different for fruit yield/hectare of ridge gourd (Table 4). The highest fruit yield/hectare (22.41 ton) was found in LA-211 and the lowest yield/hectare (8.04 ton) in LA-210 germplasm. The average fruit yield/hectare was recorded to be 11.76 ton. Gautham *et al*. (2004) reported that hybrids produced 32.5 and 19.5% higher fruit yield over the superior control hybrid NS-3.

4.3 Study of variability for yield and yield contributing characters

Genotypic and phenotypic variance, heritability, genetic advance and genetic advance in percentage of mean were estimated and presented in Table 5.

4.3.1 Days to 1st flowering

It was revealed that phenotypic variation (12.60) was higher than the genotypic variance (4.95) for indicating high environmental influence on this characters which was supported by narrow difference between phenotypic (7.73%) and genotypic (4.85%) co-efficient of variation for days to 1st flowering (Table 5). Moderate heritability (39.30%) in days to 1st flowering attached with moderate genetic advance (3.68%) and moderate genetic advance in percentage of mean (8.02). Moderate estimate of heritability and moderate genetic advance were registered in days to 1st flowering suggested that this character was predominantly controlled by environment with complex gene interaction.

4.3.2 Days to 1st harvest

Phenotypic variation (24.17) was higher than the genotypic variance (9.25) for indicating high environmental influence on this characters which was supported by narrow difference between phenotypic (7.93%) and genotypic (4.91%) co-efficient of variation for days to 1st harvest (Table 5). The difference between these parameters was also moderate suggested a considerable influence of environment on days to 1st harvest for its expression. Moderate heritability (38.26%) in days to 1st harvest attached with moderate genetic advance (4.97%) and moderate genetic advance in percentage of mean (8.01). Moderate estimate of heritability and moderate genetic advance were registered in days to 1st harvest suggested that this character was predominantly controlled by environment with complex gene interaction. Devmore *et al.* (2010) reported that the nature and magnitude of genetic variability, heritability accompanied with genetic advance as percentage of mean for days to first fruit harvest in ridge gourd.

Table 5. Genetic parameters of different yield contributing characters and yield of ridge gourd as influenced by germplasm

Characters	Genotypic variance ($\sigma^2 g$)	Phenotypic variance ($\sigma^2 p$)	Genotypic coefficient of variation (%)	Phenotypic coefficient of variation (%)	Heritability (%)	Genetic Advance (GA)	GA in percentage of mean
Days to 1st flowering	4.95	12.60	4.85	7.73	39.30	3.68	8.02
Days to 1st harvest	9.25	24.17	4.91	7.93	38.26	4.97	8.01
Fruit length (cm)	8.46	9.82	13.68	14.74	86.18	7.13	33.54
Fruit diameter (cm)	0.07	0.11	7.22	9.17	61.93	0.54	15.00
Individual fruit weight (g)	389.22	507.02	19.97	22.79	76.77	45.63	46.19
Number of fruits/plant	50.90	58.62	26.22	28.14	86.83	17.55	64.50
Fruit yield/plant (kg)	0.85	0.91	35.49	36.81	93.00	2.35	90.36
Fruit yield/plot (kg)	13.81	14.37	35.11	35.82	96.10	9.62	90.87
Weight of 100 seeds (g)	4.17	5.52	20.02	23.02	75.60	4.69	45.95
Fruit yield/hectare (ton)	17.05	17.74	35.11	35.82	96.10	10.69	90.88

4.3.3 Fruit length

From the data it was found that the fruit length in terms of phenotypic variation (9.82) was higher than the genotypic variance (8.46) for indicating high environmental influence on this character which was supported by narrow difference between phenotypic (14.74%) and genotypic (13.68%) co-efficient of variation (Table 5). The difference between phenotypic and genotypic variation then was high indicated great influence of the environment for the expression of this character. Therefore, the breeder must have to simultaneous consideration of genetic work predicted environment for improving the trait. High heritability (86.18%) for fruit length was attached with high genetic advance (33.54%) and high genetic advance in percentage of mean (7.13). As this trait possessed high variation, it was potential for effective selection for further genetic improvement. Singh *et al*. (2002) recorded high heritability with high genetic advance for fruit length in ridge gourd. Devmore *et al*. (2010) reported that the nature and magnitude of genetic variability, heritability accompanied with genetic advance as percentage of mean for fruit length in ridge gourd. Gowda (2011) reported high PCV and GCV which were observed for the characters fruit length that indicates maximum variability and offers good scope for improvement by simple selection in ridge gourd.

4.3.4 Fruit diameter

Fruit diameter in respect of phenotypic variation (0.11) was higher than the genotypic variance (0.07) for indicating high environmental influence on this characters which was supported by narrow difference between phenotypic (9.17%) and genotypic (7.22%) co-efficient of variation (Table 5). That mean the very close to phenotypic and genotypic variance which indicated that environment had played a little role with little genetic variation among the germplasms of this trait i.e. environmental influence was minimum. Therefore, diameter of fruit was the inherent potential among 10 germplasm. High heritability was found (61.93%) for diameter of fruit attached with lowest genetic advance (0.54%) and highest genetic advance in percentage of mean (15.00).

The high heritability along with high genetic advance in percentage of mean of diameter of fruit indicated the possible scope for improvement through selection of the character and breeder may expect reasonable benefit in next generation in respect of this trait. Gautham *et al*. (2004) estimates of heritability were recorded for fruit diameter, indicating the possibility of improving these characters through selection.

4.3.5 Individual fruit weight

Individual fruit weight of ridge gourd in respect of phenotypic variation (507.02) was higher than the genotypic variance (389.22) for indicating high environmental influence on this characters which was supported by narrow difference between phenotypic (22.79%) and genotypic (19.97%) co-efficient of variation (Table 5). The difference between phenotypic and genotypic variance which was high indicated great influence of the environment for the expression of this character. High heritability (76.77%) was found for individual fruit weight attached with high genetic advance (46.19%) and high genetic advance in percentage of mean (45.63). The high heritability estimate coupled with high expected genetic advance for this trait indicated the importance of both additive and non additive gene effects for controlling the character is very high. Genetic improvement of this character would therefore, be moderately effective. Singh *et al*. (2002) recorded high heritability with high genetic advance for fruit weight of ridge gourd. Gowda (2011) reported high PCV and GCV which were observed for the characters average fruit weight that indicates maximum variability and offers good scope for improvement by simple selection in ridge gourd.

4.3.6 Number of fruits/plant

It was revealed that number of fruits/plant in terms of phenotypic variation (58.62) was higher than the genotypic variance (50.90) for indicating high environmental influence on this characters which was supported by narrow difference between phenotypic (28.14%) and genotypic (26.22%) co-efficient of variation (Table 5).

The difference between phenotypic and genotypic variation then was high indicated great influence of the environment for the expression of this character. Therefore, the breeder must have to simultaneous consideration of genetic work predicted environment for improving the trait. High heritability was found (86.83%) for number of fruits/plant attached with high genetic advance (64.50%) and high genetic advance in percentage of mean (17.55). As this trait possessed high variation, it was potential for effective selection for further genetic improvement. Singh *et al*. (2002) recorded high heritability with high genetic advance for fruits/plant. Gautham *et al*. (2004) estimates of heritability were recorded for number of fruits/vine, indicating the possibility of improving these characters through selection. Gowda (2011) reported high PCV and GCV which were observed for the characters number of fruits plant that indicated maximum variability and offers good scope for improvement by simple selection in ridge gourd.

4.3.7 Fruit yield/plant

In terms of fruit yield/plant the difference between phenotypic variation (0.91) and genotypic variance (0.85) was minimum for indicating minimum environmental influence on this characters which was supported by narrow difference between phenotypic (36.81%) and genotypic (35.49%) co-efficient of variation (Table 5). The difference between phenotypic and genotypic variation was minimum which indicated moderately influence of the environment for the expression of this character. Therefore, the breeder must have to consecutive consideration of genetic work predicted environment for improving the trait. High heritability was found (93.00%) for fruit yield/plant attached with high genetic advance (90.36%) and high genetic advance in percentage of mean (2.35). As the trait possessed high variation, it was potential for effective selection for genetic improvement. Singh *et al*. (2002) recorded high heritability with high genetic advance for yield/plant. Gautham *et al*. (2004) estimates of heritability were recorded for fruit/vine, indicating the possibility of improving these characters through selection. Gowda (2011) reported high PCV and GCV which were observed for the characters fruit yield/plant that indicated maximum variability and offers good scope for improvement by simple selection in ridge gourd.

4.3.8 Fruit yield/plot

Phenotypic variation (14.37) was higher than the genotypic variance (13.81) in terms of fruit yield/plot indicating minimum environmental influence on this characters which was supported by narrow difference between phenotypic (35.82%) and genotypic (35.11%) co-efficient of variation (Table 5). The difference between phenotypic and genotypic variation then was minimum indicated moderately influence of the environment for the expression of this character. Therefore, the breeder must have to consecutive consideration of genetic work predicted environment for improving the trait. High heritability was found (96.10%) for fruit yield/plot attached with high genetic advance (90.87%) and high genetic advance in percentage of mean (9.62). As this trait possessed high variation, it was potential for effective selection for further genetic improvement without minimum consideration of environmental effect. Gowda (2011) reported high PCV and GCV which were observed for the characters fruit yield/plot that indicates maximum variability and offers good scope for improvement by simple selection in ridge gourd.

4.3.9 Weight of 100 seeds

Weight of 100 seeds in terms of phenotypic variation (5.52) was higher than the genotypic variance (4.17) for indicating high environmental influence on this characters which was supported by narrow difference between phenotypic (23.02%) and genotypic (20.02%) co-efficient of variation (Table 5). The difference between phenotypic and genotypic variation then was high indicated great influence of the environment for the expression of this trait. Therefore, the breeder must have to synchronize consideration of genetic work predicted environment for improving the trait.

High heritability was found (75.60%) for weight of 100 seeds attached with high genetic advance (45.95%) and high genetic advance in percentage of mean (4.69). As this trait possessed high variation, it was potential for effective selection for further genetic improvement. Singh *et al*. (2002) recorded high heritability with high genetic advance for 100-seed weight.

4.3.10 Fruit yield/hectare

It was revealed that in terms of fruit yield/hectare phenotypic variation (17.74) was higher than the genotypic variance (17.05) for indicating minimum environmental influence on this characters which was supported by narrow difference between phenotypic (35.82%) and genotypic (35.11%) co-efficient of variation (Table 5). The difference between phenotypic and genotypic variation then was minimum indicated moderately influence of the environment for the expression of this character. Therefore, the breeder must have to consecutive consideration of genetic work predicted environment for improving the trait. High heritability (96.10%) was found for fruit yield/hectare attached with high genetic advance (90.88%) and high genetic advance in percentage of mean (10.69%). As this trait possessed high variation, it was potential for effective selection for further genetic improvement without minimum consideration of environmental effect. Devmore *et al*. (2010) reported that the nature and magnitude of genetic variability, heritability accompanied with genetic advance as percentage of mean, for high fruit yield in ridge gourd. Gowda (2011) reported high PCV and GCV which were observed for the characters fruit yield/hectare and offers good scope for improvement by simple selection in ridge gourd. Gowda (2011) also found that high heritability coupled with high genetic advance over percent of mean was observed for the characters fruit yield/hectare and reported that these characters were governed by additive gene action and offers good scope for improvement by simple selection through these characters.

4.4 Correlation Matrix

Correlation matrix analysis was done to measure the mutual relationship among yield and yield contributing characters of ridge gourd (Table 6).

4.4.1 Days to 1st flowering

Positive association was recorded for days to 1st flowering of ridge gourd germplasm in respect of fruit length (0.334), individual fruit weight (0.121), number of fruits/plant (0.029), fruit yield/plant (0.203), fruit yield/plot (0.188), weight of 100 seeds (0.143) and fruit yield/hectare (0.188), while the negative association for days to 1st harvest (-0.140) and fruit diameter (-0.069). Both positive and negative association were non significant. Rao *et al*. (2000) reported that days to 50% flowering exhibited significant negative correlation with yield/vine and fruits/vine.

4.4.2 Days to 1st harvest

Fruit length (0.022) showed positive non significant association for days to 1st harvest, whereas negative significant association was recorded in fruit diameter (-0.365), individual fruit weight (-0.561), fruit yield/plant (-0.405), fruit yield/plot (-0.390) and fruit yield/hectare (0.390), again the negative non significant association for days to 1st flowering (-0.140), number of fruits/plant (-0.182) and weight of 100 seeds (-0.098).

4.4.3 Fruit length

Data revealed that a positive significant association was recorded for fruit length of ridge gourd germplasm in respect of individual fruit weight (0.365) and non significant positive association was recorded in days to 1st flowering (0.334), days to 1st harvest (0.022), fruit yield/plant (0.330), fruit yield/plot (0.276), weight of 100 seeds (0.068) and fruit yield/hectare (0.276), while the negative non significant association for fruit diameter (-0.128) and number of fruits/plant (-0.091). Shah and Kale (2002) reported that the fruit length was negatively correlated with fruit diameter and fruit number per vine, while it was positively correlated with the average fruit weight.

Table 6. Correlation matrix of different yield contributing characters and yield of ridge gourd as influenced by germplasm

Germplasm	Days to 1st flowering	Days to 1st harvest	Fruit length	Fruit diameter	Individual fruit weight	Number of fruits/plant	Fruit yield/ plant	Fruit yield/plot	Weight of 100 seeds	Fruit yield/hectare
Days to 1st flowering	1.00									
Days to 1st harvest	-0.140	1.00								
Fruit length	0.334	0.022	1.00							
Fruit diameter	-0.069	-0.365*	-0.128	1.00						
Individual fruit weight	0.121	-0.561**	0.365*	0.588**	1.00					
Number of fruits/plant	0.029	-0.182	-0.091	-0.138	-0.108	1.00				
Fruit yield /plant	0.203	-0.405*	0.330	0.286	0.514**	0.653**	1.00			
Fruit yield/plot	0.188	-0.390*	0.276	0.267	0.526**	0.711**	0.968**	1.00		
Weight of 100 seeds	0.143	-0.098	0.068	0.061	-0.001	-0.086	0.069	-0.018	1.00	
Fruit yield /hectare	0.188	-0.390*	0.276	0.267	0.526**	0.711**	0.968**	1.00**	-0.018	1.00

** Significant at 0.01 level of probability; * Significant at 0.05 level of probability

4.4.4 Fruit diameter

Significant positive association was recorded for fruit diameter of ridge gourd germplasm in respect of individual fruit weight (0.588) and non significant positive association was recorded in days for fruit yield/plant (0.286), fruit yield/plot (0.267), weight of 100 seeds (0.061) and fruit yield/hectare (0.267), while the negative significant association for days to 1st harvest (-0.365) and non significant negative association was recorded with days to 1st flowering (-0.069), fruit length (-0.128) and number of fruits/plant (-0.138).

4.4.5 Individual fruit weight

Significant positive association was recorded for individual fruit weight of ridge gourd germplasm in respect of fruit length (0.365), fruit diameter (0.588), fruit yield/plant (0.514), fruit yield/plot (0.526) and fruit yield/hectare (0.526), while non significant positive association was found for days to 1st flowering (0.121). On the other hand, significant negative association was recorded for days to 1st harvest (-0.561) and non significant negative association was recoded for number of fruits/plant (-0.108) and weight of 100 seeds (-0.001).

4.4.6 Number of fruits/plant

Highly positive significant association was recorded for number of fruits/plant of ridge gourd germplasm in respect of fruit yield/plant (0.653), fruit yield/plot (0.711) and fruit yield/hectare (0.711), while non significant positive association was found for days to 1st flowering (0.029). On the other hand, non significant negative association was recorded for days to 1st harvest (-0.182), fruit length (-0.091), fruit diameter (-0.138), individual fruit weight (-0.108) and weight of 100 seeds (-0.086). Shah and Kale (2002) reported significant correlations for fruit number per vine with number of female flowers per vine; branch number with vine length, internodal length and number of male flowers per vine; internodal length with average fruit weight.

4.4.7 Fruit yield/plant

It was revealed that higher positive significant association for fruit yield/plant of ridge gourd germplasm with individual fruit weight (0.514), number of fruits/plant (0.653), fruit yield/plant (0.711), fruit yield/plot (0.968) and fruit yield/hectare (0.968), while non significant positive association was found for days to 1st flowering (0.203), fruit length (0.330), fruit diameter (0.286) and weight of 1000 seeds (0.069). On the other hand, significant negative association was recorded for days to 1st harvest (-0.405). Shah and Kale (2002) reported that fruit weight/vine was positively and significantly correlated with the fruit number/vine, average fruit weight indicating the close association and dependency of yield on these characters. Rao *et al*. (2000) reported that yield/vine exhibited significant positive correlation with fruits/vine both phenotypic and genotypic levels. Shah and Kale (2002) reported that the fruit weight per vine was positively and significantly correlated with the fruit number per vine and average fruit weight.

4.4.8 Fruit yield/plot

Statistically positive significant association was recorded for fruit yield/plot of ridge gourd germplasm in respect of individual fruit weight (0.526), number of fruits/plant (0.711), fruit yield/plant (0.968) and fruit yield/hectare (1.00), while non significant positive association was found for days to 1st flowering (0.188), fruit length (0.276), fruit diameter (0.267) and weight of 1000 seeds (0.069). On the other hand, significant negative association was recorded for days to 1st harvest (-0.390).

4.4.9 Weight of 100 seeds

Positive non significant association was recorded for weight of 100 seeds of ridge gourd germplasm in respect of days to 1st flowering (0.143), fruit length (0.068), fruit diameter (0.061), fruit yield/plant (0.069), while non significant negative association was found for days to 1st harvest (-0.098), individual fruit weight (-0.001), number of fruits/plant (0.086), fruit yield/plot (-0.018) and fruit yield/hectare (-0.018).

4.4.10 Fruit yield/hectare

Positive significant association was observed for fruit yield/hectare of ridge gourd germplasm in respect of individual fruit weight (0.526), number of fruits/plant (0.711), fruit yield/plant (0.968) and fruit yield/hectare (1.00), while non significant positive association was found for days to 1st flowering (0.188), fruit length (0.276) and fruit diameter (0.267). On the other hand, significant negative association was recorded for days to 1st harvest (-0.390) and weight of 100 sees (-0.018). Gowda (2011) reported that character association for fruit yield/plant highly significant and positive association with number of fruits/plant, fruit yield/plot, fruit yield/hectare, fruit length, fruit diameter, 100 seed weight. Since, these association characters are in the desirable direction, selection for these traits will improve the yield/plant. Chowdhury and Sarma (2002) reported that correlation coefficients revealed that yield/hectare can be improved through selection for greater fruit number/plant, fruit length and girth, and individual fruit weight.

4.5 Path Co-efficient Analysis

Path co-efficient analysis screens the components of correlation into direct and indirect effects and indicates the relationship in more meaningful way. The results of path co-efficient using genotypic correlation are presented in Table 7.

4.5.1 Yield/hectare *vs* days to 1st flowering

Path analysis revealed that days to 1st flowering had positive direct effect (0.272) on yield/hectare (Table 7). It showed negligible negative indirect effect through fruit length, fruit diameter, fruit yield/plant and weight of 1000 seeds. Days to 1st flowering showed positive indirect effect through days to 1st harvest, individual fruit weight, number of fruit/plant and fruit yield/plot. Rao *et al*. (2000) reported that path analysis revealed that yield improvement could be achieved by direct selection for days to 50% flowering, in ridge gourd.

Table 7. Partitioning of genetic correlation into direct (bold) and indirect effects of yield contributing characters on yield of 10 ridge gourd germplasm by path analysis

Characters	Days to 1st flowering	Days to 1st harvest	Fruit length	Fruit diameter	Individual fruit weight	Number of fruits/ plant	Fruit yield/ Plant	Fruit yield/ plot	Weight of 100 seeds	Fruit yield/ Hectare
Days to 1st flowering	**0.272**	0.122	-0.217	-0.198	0.247	0.102	-0.143	0.094	-0.091	0.188
Days to 1st harvest	-0.034	**-0.079**	0.101	0.014	0.117	-0.209	0.015	-0.334	0.019	0.390
Fruit length	0.165	0.278	**0.178**	0.145	-0.278	0.043	0.098	-0.321	-0.032	0.276
Fruit diameter	0.199	0.133	-0.193	**0.263**	0.008	0.165	-0.078	0.121	-0.351	0.267
Individual fruit weight	0.044	0.213	-0.045	0.021	**0.085**	-0.133	0.032	0.175	0.134	0.526
Number of fruits/plant	-0.056	0.165	-0.004	0.054	-0.112	**0.254**	-0.067	0.296	0.181	0.711
Fruit yield/plant	0.421	0.131	-0.012	0.155	-0.092	0.045	**0.067**	0.008	0.245	0.968
Fruit yield/plot	-0.056	-0.075	0.161	0.287	-0.013	0.233	0.143	**0.361**	-0.041	1.000
Weight of 100 seeds	0.095	0.056	-0.046	0.066	0.142	-0.155	-0.051	0.043	**-0.132**	0.018

Residual effect = 0.2351

4.5.2 Yield/hectare *vs* days to 1st harvest

In consideration of path analysis revealed that days to 1st harvest had negative direct effect (-0.079) on yield/hectare (Table 7). It showed negligible negative indirect effect through days to 1st flowering, number of fruit/plant and fruit yield/plot. Days to 1st harvest showed positive indirect effect through fruit length, fruit diameter, individual fruit weight, fruit yield/plant and weight of 1000 seeds.

4.5.3 Yield/hectare *vs* fruit length

Path analysis revealed that fruit length had positive direct effect (0.178) on yield/hectare (Table 7). It showed negligible positive indirect effect through days to 1st flowering, days to 1st harvest, fruit diameter, number of fruits/plant and fruit yield/plant. Fruit length showed negative indirect effect through individual fruit weight, number of fruit/plot and weight of 100 seeds.

4.5.4 Yield/hectare *vs* fruit diameter

It was revealed from path analysis that fruit diameter had positive direct effect (0.263) on yield/hectare (Table 7). It showed negligible positive indirect effect through days to 1st flowering, days to 1st harvest, individual fruit weight, number of fruits/plant and fruit yield/plot. Fruit diameter showed negative indirect effect through fruit length, fruit yield/plant and weight of 100 seeds.

4.5.5 Yield/hectare *vs* individual fruit weight

Path analysis revealed that individual fruit weight had positive direct effect (0.085) on yield/hectare (Table 7). It showed negligible positive indirect effect through days to 1st flowering, days to 1st harvest, fruit diameter, fruit yield/plant, fruit yield/plot and weight of 1000 seeds. Individual fruit weight showed negative indirect effect through fruit length and number of fruits/plant. Rao *et al*. (2000) found that path analysis revealed yield improvement could be achieved by direct selection for individual fruit weight of the vine in ridge gourd.

4.5.6 Yield/hectare *vs* number of fruits/plant

Number of fruits/plant had positive direct effect (0.254) on yield/hectare path analysis revealed this (Table 7). It showed negligible positive indirect effect through days to 1st harvest, fruit diameter, fruit yield/plot and weight of 100 seeds. Number of fruit/plant showed negative indirect effect through days to 1st flowering, fruit length, individual fruit weight and fruit yield/plant. Gowda (2011) reported that path co-efficient analysis revealed that number of fruits/plant and average fruit weight had high direct effect on fruit yield/plant.

4.5.7 Yield/hectare *vs* fruit yield/plant

Path analysis revealed that fruit yield/plant had positive direct effect (0.067) on yield/hectare (Table 7). It showed negligible positive indirect effect through days to 1st flowering, days to 1st harvest, fruit diameter, number of fruits/plant, fruit yield/plot and weight of 100 seeds. Fruit yield/plant showed negative indirect effect through fruit length and individual fruit weight.

4.5.8 Yield/hectare *vs* fruit yield/plot

It was revealed that path analysis on fruit yield/plot had positive direct effect (0.361) on yield/hectare (Table 7). It showed negligible positive indirect effect through fruit length, fruit diameter, number of fruits/plant, fruit yield/plant. Fruit yield/plot showed negative indirect effect through days to 1st flowering, days to 1st harvest, individual fruit weight and weight of 100 seeds.

4.5.9 Yield/hectare *vs* weight of 100 seeds

Path analysis revealed that weight of 100 seeds had negative direct effect (-0.132) on yield/hectare (Table 7). It showed negligible positive indirect effect through days to 1st flowering, days to 1st harvest, fruit diameter, individual fruit weight and fruit yield/plot. Weight of 100 seeds showed negative indirect effect through fruit length, number of fruits/plant and fruit yield/plant. Choudhary *et al*. (2008) reported that positive and significant association of yield/plant with fruit length and fruit weight at both genotypic and phenotypic level indicating that selection based on these characters either in combination or alone will result in identifying the genotypes having high yield potent

CHAPTER V

SUMMARY AND CONCLUSION

The experiment was conducted during the period from April to August 2012 with a view to study genetic variability, character association and path co-efficient analysis of ridge gourd germplasm at the experimental field of Regional Horticulture Research Station, Mojlishpur, Shibpur, Narsingdi. Nine advance ridge gourd germplasm with one local ridge gourd line were incorporated in this study. The experiment was conducted in Randomized Complete Block Design with three replications.

Variations in relation to different morphological characters were observed among the germplasm. The entire germplasm produced flower had yellow in color. Blossom end shape of the fruits for most of the germplasm was pointed while it was depressed for the germplasm LA-212, rounded for LA-216, and flattened for LA-217. Stem end fruit shape was also mostly pointed except the germplasm LA-212 and LA-217 which exhibited flattened and rounded stem end fruit shape, respectively. Ridge gourd germplasm were also differed for fruit shape. The germplasm of LA-201, LA-208, LA-211, LA-214, LA-216 and Local variety had elongated tapered fruit shape. Elliptical (LA-206), elongate slim (LA-210), pyriform (LA-212) and elongate elliptical (LA-217) fruit shape were also recorded among the germplasm. The germplasm LA-201 & LA-210 had prominent intensity of ribs, while intensity of ribs for LA-206 and LA-214 was superficial. The intensity of ribs of other germplasm was intermediate in nature. Fruit colour of the germplasm was classified in to three groups viz., deep green, green and light green. The fruit color of the germplasm LA-201 and LA-208 were deep green while LA-206, LA-211, LA-212 and LA-214 had green fruit color and the rest germplasm produced fruits with light green in color. Among the lines, five germplasm produced fruit with high fruit uniformity while the rest produced fruit had medium fruit uniformity.

In yield contributing characters and yield, the maximum days to 1^{st} flowering (48.00) was observed in LA-211 and LA-210, whereas the minimum days (39.67) in Local variety. The maximum days to 1^{st} harvest (69.67) was found in Local variety and the minimum days (57.00) in LA-211. The longest fruit (26.32 cm) was recorded in LA-201 and the shortest fruit (17.60 cm) in LA-206. Data revealed that the highest fruit diameter (4.21 cm) was observed in LA-217 and the lowest fruit diameter (3.29 cm) in LA-210. The highest weight of individual fruit weight (137.55 g) was obtained in LA-211 and the lowest weight (73.55 g) in LA-208. It was found that the maximum number of fruits/plant (38.15) was observed in LA-208 and the minimum number (16.00) in LA-217. The highest fruit yield/plant (5.04 kg) was found in LA-211 and the lowest yield/plant (1.81 kg) in LA-210. The highest fruit yield/plot (20.17 kg) was recorded in LA-211 and the lowest yield/plot (7.24 kg) in LA-210. The highest weight of 100 seeds (15.00 g) was found in LA-216 and the lowest weight (7.80 g) in Local variety. The highest fruit yield/hectare (22.41 ton) was found in LA-211 and the lowest yield/hectare (8.04 ton) in LA-210.

In genotypic and phenotypic variance, heritability, genetic advance and genetic advance in percentage of mean, in days to 1^{st} flowering attached with phenotypic variation (12.60) was higher than the genotypic variance (4.95) with moderate heritability (39.30%) and moderate genetic advance (3.68%) and moderate genetic advance in percentage of mean (8.02). For days to 1^{st} harvest phenotypic variation (24.17) was higher than the genotypic variance (9.25) with moderate heritability (38.26%) and moderate genetic advance (4.97%) and moderate genetic advance in percentage of mean (8.01). Fruit length in terms of phenotypic variation (9.82) was higher than the genotypic variance (8.46) with high heritability (86.18%) attached with high genetic advance (33.54%) and high genetic advance in percentage of mean (7.13%). Fruit diameter in respect of phenotypic variation (0.11) was higher than the genotypic variance (0.07) and high heritability (61.93%) attached with lower genetic advance (0.54%) and highest genetic advance in percentage of mean (15.00). Individual fruit weight of ridge gourd in respect of phenotypic variation (507.02) was higher than the genotypic variance (389.22) with high heritability (76.77%) with high genetic advance (46.19%) and high genetic advance in percentage of mean (45.63). Number of fruits/plant in terms of phenotypic variation (58.62) was higher than the genotypic variance (50.90) with high heritability (86.83%) attached with high genetic advance (64.50%) and high genetic advance in percentage of mean (17.55%). Fruit yield/plant in terms of phenotypic variation (0.91) was higher than the genotypic variance (0.85) with high heritability (93.00%) with high genetic advance (90.36%) and high genetic advance in percentage of mean (2.35%). Phenotypic variation (14.37) was higher than the genotypic variance (13.81) in terms of fruit yield/plot with high heritability (96.10%) with high genetic advance (90.87%) and high genetic advance in percentage of mean (9.62%). Weight of 100 seeds for phenotypic variation (5.52) was higher than the genotypic variance (4.17) with high heritability (75.60%) attached with high genetic advance (45.95%) and high genetic advance in percentage of mean (4.69%). Fruit yield/hectare in terms of phenotypic variation (17.74) was higher than the genotypic variance (17.05) with high heritability (96.10%) attached with high genetic advance (90.88%) and high genetic advance in percentage of mean (10.69%).

Days to 1st flowering of ridge gourd had both positive and negative non significant association. Fruit length showed negative significant association in fruit diameter (-0.365), individual fruit weight (-0.561), fruit yield/plant (-0.405), fruit yield/plot (-0.390) and fruit yield/hectare (0.390). Data revealed that a positive significant association was recorded for fruit length of ridge gourd in respect of individual fruit weight (0.365). Significant positive association was recorded for fruit diameter of ridge gourd in respect of individual fruit weight (0.588), while the negative significant association for days to 1st harvest (-0.365). Significant positive association was recorded for individual fruit weight of ridge gourd in respect of fruit length (0.365), fruit diameter (0.588), fruit yield/plant (0.514), fruit yield/plot (0.526) and fruit yield/hectare (0.526) and significant negative association was recorded for days to 1st harvest (-0.561).

Positive significant association was recorded for number of fruits/plant of ridge gourd in respect of fruit yield/plant (0.653), fruit yield/plot (0.711) and fruit yield/hectare (0.711). It was revealed that positive significant association was recorded for fruit yield/plant of ridge gourd in respect of individual fruit weight (0.514), number of fruits/plant (0.653), fruit yield/plant (0.711), fruit yield/plot (0.968) and fruit yield/hectare (0.968), while significant negative association was recorded for days to 1st harvest (-0.405). Statistically positive significant association was recorded for fruit yield/plot of ridge gourd in respect of individual fruit weight (0.526), number of fruits/plant (0.711), fruit yield/plant (0.968) and fruit yield/hectare (1.00), while significant negative association was recorded for days to 1st harvest (-0.390). Positive significant association was observed for fruit yield/hectare of ridge gourd in respect of individual fruit weight (0.526), number of fruits/plant (0.711), fruit yield/plant (0.968) and fruit yield/hectare (1.00), while significant negative association was recorded for days to 1st harvest (-0.390).

Path analysis revealed that days to 1st flowering had positive direct effect (0.272), days to 1st harvest had negative direct effect (-0.079), fruit length had positive direct effect (0.178), fruit diameter had positive direct effect (0.263), individual fruit weight had positive direct effect (0.085), number of fruits/plant had positive direct effect (0.254), fruit yield/plant had positive direct effect (0.067), fruit yield/plot had positive direct effect (0.361), weight of 100 seeds had negative direct effect (-0.132) on yield/hectare.

Conclusion:

Considering the above findings of the present experiment, the following conclusion may be made:

1. Based on the performance of ten ridge gourd genotypes, LA-211 was found to be the highest yielder and the other genotypes showed much less yields compared to the former. So the genotype LA-211 was found to be promising for the development of a ridge gourd variety.

2. Genetical analysis revealed that days to 1^{st} flowering, fruit length, fruit diameter, individual fruit weight, number of fruit per plant, fruit yield per plot showed positive direct effect on yield. Therefore, for the selection of ridge gourd genotypes the above parameters should have to be taken with due consideration by a plant breeder.

Recommendation:

Considering the above findings of the present experiment, the following recommendations and suggestions may be made.

1. Such study is needed in different agro-ecological zones (AEZ) of Bangladesh for regional adaptability and other performance.

2. It is recommended to include more number of germplasm for variability assessment.

3. Promising germplasm LA-211 may be subjected for regional yield along with realeased variety with a view to develop new variety.

REFERENCES

Allard, R. W. 1960. Principles of Plant Breeding. John Willey and Sons, Inc, New York. p. 36.

BBS. 2011. Monthly Statistical Bulletin of Bangladesh. Bangladesh Bureau of Statistics, Ministry of Planning. Government of the People's Republic of Bangladesh, Dhaka. p. 42.

Bhandari, M. M. 1979. Practical in Plant Breeding. 2nd ed. Oxford & IBH Publishing Co. New Delhi, India. 244 p.

Bose, T. K. and Som, M. G. 1986. Vegetable Crops in India. Naya Prokash. 206. Bidhausarani, Calculta, India. pp. 107-114.

Burton, G.W. 1952. Quantitative inheritance in grass pea. Proceedings of the 6th *Internl. Grassland Congr.*, **1**: 277-283.

Choudhary, B. R., Pandey, S., Bhardwaj, D. R., Yadav, D. S. and Rai, M. 2008. Component analysis for quantitative traits in ridge gourd (*Luffa acutangula* L.). *Veg. Sci*., **35**(2): 144-147.

Chowdhury, D. and Sarma, K. C. 2002. Studies on variability, heritability, genetic advance and correlations in ridge gourd (*Luffa acutangula* L.). *Hort. J*., **15**(3): 53-58.

Comstock, K. and Robinson, P. R. 1952. Estimation of genetic advance. *Indian J. Hill*., **6**(2): 171-174.

Devmore, J. P., Dhonukshe, B. L., Thaware, B. L., Bendale, V. W., Jadhav, B. B. and Thprat, T. N. 2010. Genetic variability and heritability studies in ridge gourd. *J. Maharashtra Agril. Univ*., **35**(1): 163-165.

Dewey, D. R. and Lu, K. H. 1959. A correlation and path coefficient analysis of components of vegetables seed production. *Agron. J. Hort.*, **57**(4): 342-346.

Edris, K. M., Islam, A. T. M. T., Chowdhury, M. S. and Haque, A. K. M. M. 1979. Detailed Soil Survey of Bangladesh, Dept. Soil Survey, Govt. People's Republic of Bangladesh. 118 p.

FAO. 1988. Production Year Book. Food and Agricultural Organizations of the United Nations. Rome, Italy. pp. 190-193.

Fertilizer Recommendation Guide. (2005). Bangladesh Agriculture Research Council (BARC), Farmgate, Dhaka. 218p.

Gaur, P., Gupta, C. and Kishore, H. 1978. Studies on genetic divergence in potato. *Euphytica*, **27**: 361-368.

Gautham, B., Neeraja, G. and Reddy, I. P. 2004. Evaluation of promising hybrids in ridge gourd (*Luffa acutangula* L.). *J. Res. Angrau*., **32**(4): 34-38.

Golakia, P. R. and Maken, V. G. 1992. D^2 analysis in *Virginia runner* groundnut genotypes. *Indian J. Genet*., **52**(3): 252-256.

Gomez, K. A. and Gomez, A. A. 1984. Statistical Procedure for Agricultural Research (2nd edn.). Int. Rice Res. Inst., A Willey Int. Sci., pp. 28-192.

Gowda. H. 2011. Genetic Variability Studies in Ridge Gourd (*Luffa Acutangula* L.). An M.Sc thesis. University of Horticultural Sciences, Bagalkot, India. P. 148.

Hedau, N. K. and Sirohi, P. S. 2004a. A diallel studies in ridge gourd (*Luffa acutangula* L.). *Orissa J. Hort*., **32**(1): 13-14.

Hedau, N. K. and Sirohi, P. S. 2004b. Combining ability for yield and its contributing characters in ridge gourd. *Prog. Hort*., **36**(1): 91-93.

Hedau, N. K. and Sirohi, P. S. 2004c. Heterosis studies in ridge gourd. *Indian J. Hort*., **61**(3): 236-239.

Jawadagi, R. S., Mastanareddy, B. G., Hebbara, M., Patil, S. G. and Reddy, B. S. S. 2002. Performance of ridge gourd (*Luffa accutangula* L.) genotypes under different salinity condition of Tungabhadra project area. *Karnataka J. Agril. Sci*., **15**(3): 602-604.

Johnson, H. W., Robinson, H. F. and Comstock, R. E. 1955. Estimation of genetic and environmental variability in soybeans. *Agron. J*., **47**: 314-318.

Kumar, S., Singh, R. and Pal, A. K. 2007. Genetic variability, heritability, genetic advance, correlation coefficient and path analysis in ridge gourd. *Indian J. Hort*., **64**(2): 163-168.

Mole, T. J., Devi, S. N., Rajan, S. and Sadhankumar, P. G. 2001. Heterosis and combining ability in ridge gourd (*Luffa acutangula* L.). *Vegetable Sci*., **28**(2): 165-167.

Prasanna, S. C., Krishnappa, K. S. and Reddy, N. S. 2002. Correlation and path coefficient analysis studies in ridge gourd. *Agril. Sci.*, **31**(9/10): 150-152.

Rao, B. N. and Rao, P. V. 2002. Heterosis in ridge gourd (*Luffa acutangula* L.). *J. Res.*, **30**(1): 11-18.

Rao, B. N., Rao, P. V. and Reddy, B. M. 2000. Heterosis in ridge gourd (*Luffa acutangula* L.). *Haryana J. Hort. Sci*., **29**(1/2): 96-98.

Rao, B. N., Rao, P. V. and Reddy, B. M. M. 2000. Correlation and path analysis in the segregating population of ridge gourd (*Luffa acutangula* L.). *Crop Res. Hisar*., **20**(2): 338-342

Rao, B. N., Rao, P. V. and Reddy, T. B. 1999. Correlation and path-coefficient studies in ridge gourd (*Luffa acutangula* L.). *Intl. J. Trop. Agric*., **17**(1/4): 119-124.

Shah, S. R. and Kale, P. N. 2002. Yield component association analysis in ridge gourd. *J. Maharashtra Agril. Univ*., **27**(2): 197-198.

Shaha, S. R. and Kale, P. N. 2001. Studies on heterosis and combining ability in ridge gourd. *Adv. Hort.*, **8**: 159-165.

Shaha, S. R. and Kale, P. N. 2003a. Heterosis studies in ridge gourd. *J. Maharashtra Agril. Univ*., **28**(3): 334-336.

Shaha, S. R. and Kale, P. N. 2003b. Diallel analysis for combining ability in ridge gourd. *J. Maharashtra Agril. Univ*., **28**(3): 252-254.

Shaha, S. R., Kale, P. N. and Navale, P. A. 1999. Combining ability analysis in ridge gourd. *J. Maharashtra Agril. Univ*., **24**(2): 133-135.

Shinde, S. J., Nilangekar, R. G., Barkule, S. R., Hingole, D. G. Kadam, A. S. and Sukase, K. A. 2003a. Studies on fruit characteristics of different ridge gourd (*Luffa acutangula* L.) genotypes. *J. Soils & Crops*, **13**(1): 52-55.

Shinde, S. J. Nilangekar, R. G., Barkule, S. R., Hingole, D. G., Kadam, R. P. and Keshbhat, S. S. 2003b. Growth performance and yield of different ridge gourd (*Luffa acutangula* L.) genotypes. *J. Soils & Crops*., **13**(1): 65-68.

Singh, D. 1983. Biometrical and genetical studies in okra (*Abelmoschus esculentus*). A Ph. D. dissertation, Punjab Agril. Univ., Ludhiana. India. p. 74-78.

Singh, R. K. and Chaudhury, B. D. 1985. Biometrical Method in Quantitative Genetics Analysis (rev. ed.). Kalyain Publishers, New Delhi, India, pp. 78-85.

Singh, R. P., Mohan, J. and Dharmendra, S. 2002. Studies on genetic variability and heritability in ridge gourd (*Luffa acutangula* L.). *Agril. Science Digest*., **22**(4): 279-280.

Tyagi, S. V. S., Khandelwal, R. C. and Maurya, I. B. 2003. Combining ability analysis over environments for fruit yield and other traits in ridge gourd (*Luffa acutangula* L.). *Sci. Hort*., **8**: 149-157.

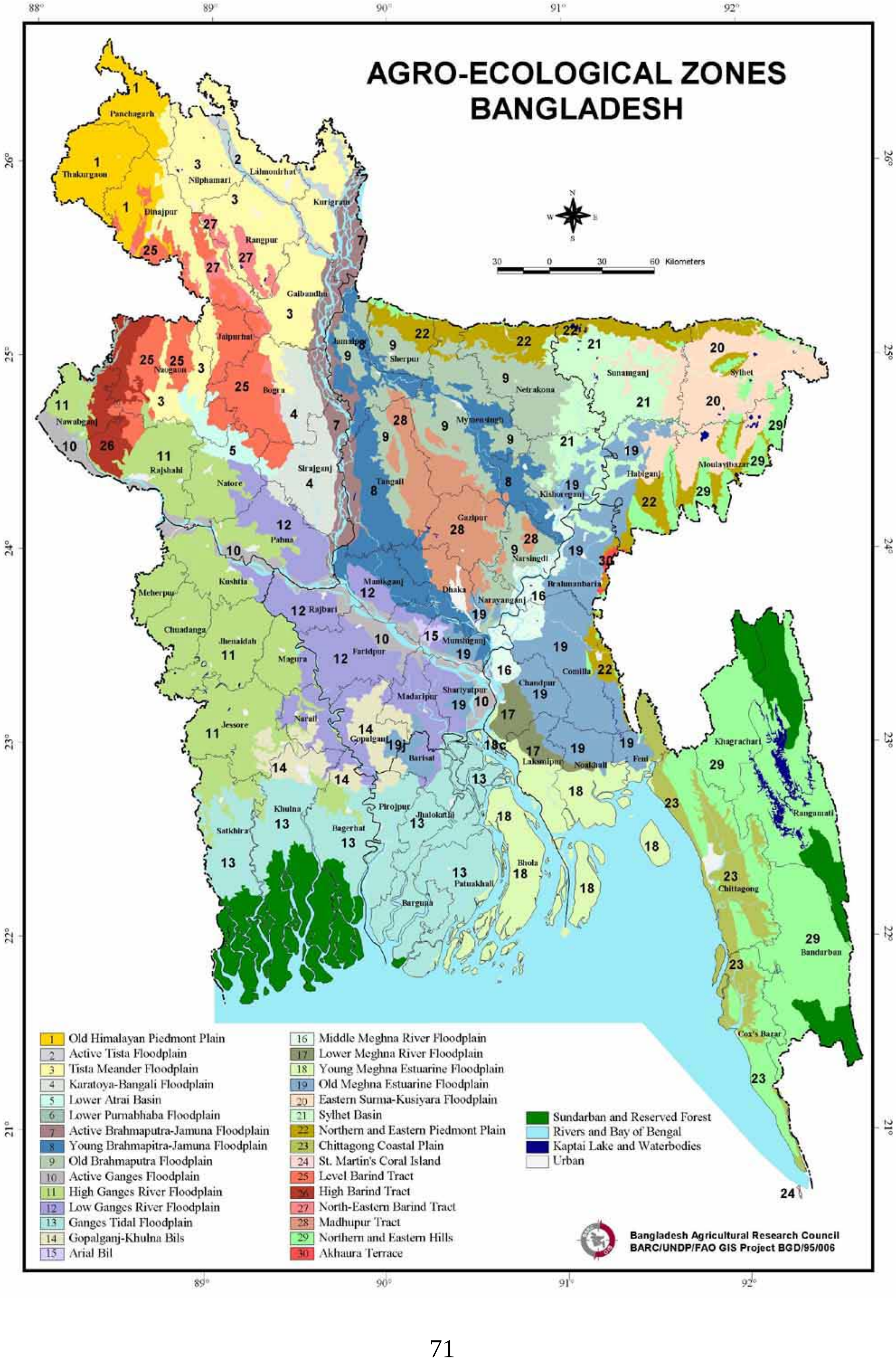
UNDP. 1988. Land Resources Appraisal of Bangladesh for Agricultural Development. Report 2: Agro-ecological Regions of Bangladesh, FAO, Rome. pp. 77.

van Hintum,T. J. L. 1995. Hierarchical approaches to the analysis of genetic diversity in crop plants. In: T. Hodgkin, A. H. D. Brown, Th. L. van Hintum and E. A. V. Morales (eds.); Core Collection of Plant Genetic Resources, John Wiley and Sons, U. K. pp. 23.24.

Yawalkar, K. S. 1985. Vegetable crops of India. 3rd ed. Agric. Horticultural Publishing House. Nagpur. 440010. pp. 166-170.

APPENDICES

Appendix I. Photograph showing Agro-Ecological Zones (AEZ) of Bangladesh



Appendix II. Characteristics of the soil of experimental field

A. Morphological characteristics of the experimental field

Morphological features	Characteristics
Location	Regional Horticulture Research Station, Mojlishpur, Shibpur, Narsingdi
AEZ	Madhupur Tract (28)
General Soil Type	Shallow red brown terrace soil
Land type	Medium high land
Soil series	Kalma
Drainage	Not well drained

B. Physical and chemical properties of the initial soil

Characteristics	Value
% Sand	27
% Silt	43
% clay	30
Textural class	Silty-clay
pH	6.3
Organic carbon (%)	0.45
Organic matter (%)	0.78
Total N (%)	0.04
Available P (ppm)	22.00
Exchangeable K (me/100 g soil)	0.12
Available S (ppm)	28

Source: Soil Resources Development Institute (SRDI)

Appendix III. Monthly record of air temperature, relative humidity, rainfall, and sunshine (average) of the experimental site during the period from April to August, 2012

Month (2012)	Air temperature (^{0}c)		Relative humidity (%)	Rainfall (mm)	Sunshine (hr)
	Maximum	Minimum			
April	34.2	23.4	61	112	8.1
May	34.7	25.9	70	185	7.8
June	35.4	22.5	80	577	4.2
July	36.0	24.6	83	563	3.1
August	36.0	23.6	81	319	4.0

Source: Bangladesh Meteorological Department (Climate & weather division) Agargoan, Dhaka–1212

Appendix IV. Analysis of variance of the data on yield contributing characters and yield of ridge gourd as influenced by germplasm

Source of variation	Degrees of freedom	Mean square				
		Days required for 1st flowering	Days required for 1st harvest	Fruit length (cm)	Fruit diameter (cm)	Individual fruit weight (g)
Replication	2	5.833	0.700	0.186	0.000	5.184
Germplasm	9	22.504*	42.667*	26.739**	0.247**	1285.455**
Error	18	7.648	14.922	1.357	0.042	117.800
CV(%)		6.02	6.23	5.48	5.68	10.99

**: Significant at 0.01 level of probability; *: Significant at 0.05 level of probability

Appendix IV. Cont'd

Source of variation	Degrees of freedom	Mean square				
		Number of fruits/plant	Fruit yield/plant (kg)	Fruit yield/plot (kg)	Weight of 100 seeds (g)	Fruit yield/ hectare (ton)
Replication	2	0.023	0.014	0.002	0.240	0.003
Germplasm	9	160.433**	2.613**	41.998**	13.867**	51.849**
Error	18	7.720	0.064	0.561	1.347	0.692
CV(%)		10.21	9.75	7.08	11.37	7.08

**: Significant at 0.01 level of probability;

LA-

LA-206

LA-

LA-210

Plate 1. Photograph showing fruits of different ridge gourd germplasm