Genetic Evaluation and Nutritional Study of Baby Corn and Green Ear for Fodder Purpose

Tajwar Izhar[1*], Manigopa Chakraborty[2], Naiyar Ali[3]

[1]Assistant Professor cum-Jr-Scientist, Department of Forage Breeding, LPM, RVC, Ranchi, India
[2]Chief Scientist, Department of GPB, BAU, Ranchi, India
[3]Jr-Scientist cum-Assistant Professor, Department of Agronomy, Birsa Agricultural University, Ranchi, Jharkhand, India
*Corresponding Author: tajwar_bau@ rediffmail.com

Abstract. Green forages are rich and cheapest source of carbohydrates, protein, vitamins and minerals for dairy animals. To meet out the needs of the ever increasing livestock population the production as well productivity of fodder is to be increased. Maize crop has an important place in the food grain basket of our country and is the third most important versatile food grain crop due to its importance in food, feed, specialty corn, starch etc. In this experiment, twelve inbred lines were crossed with each of five testers in a line×tester design to evaluate combining ability and heterosis to identify promising hybrids of green cob and baby corn for fodder purpose with various characters like, 50% tasseling, 50% silking, 75% dry husk, grain yield, no. and weight of green ears, green fodder yield, dry weight, pericarp thickness and various quality parameters. The resulting F_1s along with three checks and seventeen parents were evaluated in two environments during *kharif* 2010 and *rabi* 2010-11. Crosses excelled their perspective parents in performance for most of the traits studied. BQPM-2 among the parental lines and BAUIM-2 among the testers were identified as the best general combiners for grain yield and green fodder yield. Whereas among the hybrids, BAUIM-4×HKI-163 and BQPM-2×HKI-163 were identified as potential cross combinations for grain yield and green fodder yield. However for quality parameters, BQPM-2×BAUIM-2 exhibited the highest magnitude of economic heterosis for calcium, crude fibre, dry ash and reducing sugar contents while for iron and phosphorus contents, BAUIM-4×HKI 163 exhibited the most desirable value of heterosis. So the crosses (BAUIM-4×HKI 163) and (BQPM-2×BAUIM-2) can be utilized for developing high yielding hybrid varieties as well as for exploiting hybrid vigor. While for baby corn as feed for animals, several quality parameters like moisture, calcium, iron, phosphorus, total soluble sugars, crude fibre and dry ash contents) baby corn yield were studied. The inbred line BAUIM-4 followed by BQPM-2 was a good general combiner for all the quality traits and baby corn yield. Single cross BQPM-2 × BAUIM-2 had positive significant specific combining ability effects for all the quality traits and baby corn yield.

Index Terms: Genetic Evaluation, Baby Corn, Green Ear for Fodder, Nutritional Study

I. INTRODUCTION

The agricultural production systems in India are based upon mixed farming in which two major enterprises are crops and livestock. To meet out the needs of the ever increasing livestock population the production as well productivity of fodder is to be increased.

India inhabits 15% of world livestock on 2% geographical area with 5.23% cultivated fodder area. Livestock share to the total Indian agriculture gross value product is increasing gradually over the years. Farmers mix these two enterprises to diversify the use of their resources for maximizing family income. Livestock production is the backbone of Indian agriculture contributing 7% to National GDP and a source of employment and ultimate livelihood for 70% of the population in rural areas. The growth rate of livestock sector is higher than the crop sector due to assured high income and increasing demand for milk and its products. But one of the critical challenge to animal productivity with the existing feeding strategy and management practices. The less livestock productivity in India is due to availability of quality feed and it alone contributes nearly 60 % of the total cost of milk production. The efficient utilization of both cultivable and non-cultivable lands coupled with latest agronomical intervention helps to improve the dairy industries. The importance of green forages in our country is well recognized since feeding forages alone accounts for over 60% of the cost of milk production. Moreover, the nutrients from the fodders are easily digestible as compared to the nutrients form concentrates. The lush green forages are palatable and are liked by the animals very much to fill their stomach to satisfy the hunger.

Maize is one of the most versatile emerging crops having wider adaptability under varied agro-climatic conditions. As it has yield potential far higher than any other cereal, it is sometimes referred to as the miracle crop or the ‘Queen of Cereals’. Maize stover consists of the leaves and stalks of maize plants left in a field after harvest and consists of the residue: stalk; the leaf, husk, and cob remaining in the field following the harvest of cereal grain. It makes up about half of the yield of a crop. The stover can also contain other weeds and grasses the non-grain part of harvested corn and has low water content

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and is very bulky. Maize straw is used as animal fodder since the ancient times. However, the fodder quality of green maize is far excellent. Amongst the non-legume cultivated fodders, maize is the only fodder which produces better nutritional quality along with good quantity of biomass. This is an area where maize can play an important role as animal fodder. Apart from furnishing the nutritional needs of the mankind maize could also fulfill the nutritional requirement of livestock. The baby corn maize stalks are green, succulent, nutritious and possess excellent digestibility.

Here in this experiment both green ear and baby corn parameters are studied for fodder purpose. Cultivation of maize for green ear and grain production are the common practices in India. At present, the country faces a net deficit green fodder, dry crop residues and feeds. So, there is an increasing demand for increasing the productivity of green fodder yield. Immature ears harvested in 25 to 28 days after pollination with moisture content of 70 to 80% is called green ear corn. In India, green ear maize finds its importance as food point of view as well a rich source of animal feed. Cultivation of maize harvested as green ear has several distinct advantages (Paliwal, 2001). Maize harvested as green ear do not face the problem of ear rot and grain insect damage in field. It is a shorter duration crop and occupies field for fewer days thus permitting more intensive cropping pattern. Green plant left over after harvesting of green ear provides better fodder for livestock than dry stover. Farmers can get more return from green ear harvest than grain yield.

Efforts are, therefore, required to develop hybrids with high yield potential in order to increase production of maize along with high tonnage of biomass. On account of more emphasis on food production at the national level the actual potential of quality fodder production for animal feed has not yet been fully tapped in the country which needs to be accomplished. Most efficient use of such materials would be possible only when adequate information on the amount and type of genetic variation and combining ability effects existing in the genetic materials. Heterosis and combining ability is prerequisite for developing a good economically viable hybrid maize variety. Combining ability analysis is useful to assess the potential inbred lines and also helps in identifying the nature of gene action involved in various quantitative characters. This information is helpful to plant breeders for formulating hybrid breeding programmes. Information on the heterotic patterns and combining ability among maize germplasm is essential in maximizing the effectiveness of hybrid development by (Beck *et al.* (1990). In maize, appreciable percentage of heterosis for yield and combining ability were earlier reported by Roy *et al*. (1998), Paul *et al.* (1999) and Rokadia *et al*. (2005). A wide array of biometrical tools is available to breeders for characterizing genetic control of economically important traits as a guide to decide upon an appropriate breeding methodology to involve in hybrid breeding. Line×tester mating design developed by Kempthorne (1957), which provides reliable information on the general and specific combining ability effects of parents and their hybrid combinations was used to generate the information. The design has been widely used in maize by Sharma *et al*. (2004) and others and continues to be applied in quantitative genetic studies. Considering the diversified uses of maize, interest has been demonstrated for the evaluation of maize hybrids with regard to their green fodder yield and grain yield production ability.

For diversification and value addition as well as growth of food processing industries leading to the development of growing maize for vegetable purpose, which is known as 'Baby corn'. It is a young finger like unfertilized cob of maize with one to three centimeter emerged silk preferably harvested within 1-3 days of silk emergence depending upon the growing season. Baby corn is highly nutritive and its nutritional quality is on par or even superior to some of the seasonal vegetables. Besides protein, vitamins and iron it is one of the richest source of phosphorus. It is also free from residual effects of pesticides, as the young cobs are wrapped up within the husk and well protected from diseases, insects, fungicides and insecticides (Sain Dass *et al*., 2007). Improvements on the part of the breeders have resulted in the development of number of varieties. Hence the present investigation was planned to evaluate various maize genotypes for chemical composition and yield at baby corn stage for fodder porpose.

II. MATERIALS AND METHODS

Twelve parental lines were crossed with five testers in a line × tester mating design during *kharif* 2010 to generate 60 hybrids along with two checks, BVM-2 and Suwan and evaluated in a randomized block design in three replications at B.A.U research farm, Ranchi. Each experimental plot consisted of two rows of 2.5m length with 65 × 20 cm spacing.

Baby corn was harvested after 1-1.5 cm silk emergence. Plants were detassled for baby corn purpose at the time of flowering. Weight was recorded in an electronic balance. Moisture content was estimated by oven dry method. Calcium and iron contents were determined in the di-acid digest of plant sample using AAS. Phosphorus content was determined using vanadomolybdophosphoric yellow colour method. Sugar content was determined by Nelson-Somogyi's method. Crude fibre content was estimated according to standard AOAC (1980). Ash content was determined by the ignition of dried sample in muffle furnace at 550°C until the residue obtained was of dusty grey colour (Anon., 1990).

Line × tester analysis involving 12 inbred lines and 5 testers in baby corn and green ear maize and their F_1 hybrids was carried out in *kharif* 2010 to assess combining ability and heterosis for quality parameters (moisture, calcium, iron, phosphorus, total soluble sugars, crude fibre and dry ash contents) baby corn and green ear yield. These 60 hybrids and seventeen parental lines with three standard checks viz., HQPM-1, Vivek Hybrid-9 and Suwan were grown in a randomized block design in three replications. All the characters were studied following the standard methods. Combining ability analysis was carried as per procedure given by Kempthorne (1957). All the characters were studied following the standard methods while the pericarp thickness of kernel was studied following the methods of Helm and Zuber (1972) as modified by Ito and Brewbaker (1991).

III. RESULTS AND DISCUSSION

Pooled analysis of variance to test the significance of difference among the genotypes revealed highly significant differences for most of the traits reflecting thereby presence of adequate diversity in the genetic material chosen for the study.

The analysis of combining ability effects revealed that none of the parents possessed desirable *gca* effects for all the traits studied. For green fodder yield and dry weight of green ears, BAUIM-1, followed by BAUIM-3, CM 111 and BQPM-2 revealed highly significant positive gca effect (Table 1 and 2). For pericarp thickness, lines, CM 111, BAUIM-3, V 341 and 1025 exhibited the most desirable value of gca effect. For various quality attributes, the inbreds viz., BAUIM-4, BQPM-2 and BQPM-4 exhibited the best quality parameters, like calcium, iron, phosphorus, reducing sugars, crude fibre and dry ash contents (Table 3). The lines with desirable *gca* should be extensively used in the crossing programme to exploit maximum genetic variability.

A critical evaluation of the results with respect to specific combining ability effects showed that none of the cross combinations exhibited desirable significant sca effects for all the characters. The estimates of specific combining ability based on pooled analysis demonstrated various cross combinations having significant positive *sca* effects (Table 4 and 5). For number of green ears per plant, V 341×BAUIM-2 and V 341×K-1105 revealed the highest positive sca effect while for weight of green ears per plant, BAUIM-4×HKI-163 and BQPM-2×HKI-163 revealed the highest magnitude of desirable *sca* effects. For green fodder yield and dry weight, BQPM-2×HKI 193-1 showed the maximum positive and highly significant sca effect followed by CM 111×K-1105. For pericarp thickness, BQPM-4×HKI 193-1 revealed the most desirable sca effect followed by BQPM-2 ×HKI-163 (Table 3). The maximum positive and highly significant sca effect was exhibited by BQPM-4×K-1105 for calcium and crude fibre contents, while for iron and phosphorus contents, BQPM-2×BAUIM-2 exhibited the most desirable value and for reducing sugar content, BQPM-4×BAUIM-2 exhibited the most desirable value of sca effect (Table 3). The superiority of crosses as parents could be explained on the basis of interaction between positive alleles from good combiners and negative alleles for the poor combiners as parents. The high yield of such crosses would be non-fixable and thus could be exploited for heterosis breeding.

All the crosses exhibited highly significant positive heterosis over mid parent and better parent for grain yield in pooled analysis. The cross combination (BQPM-2×BAUIM-2) followed by (1025×BAUIM-2) and (BQPM-2×HKI163) revealed highest magnitude of economic heterosis (84.60%) over the best check Vivek hybrid-9 for grain yield in q/ha. Appreciable percentage of heterosis for grain yield in maize was also reported by Lonnquist and Gardner (1961), Akhtar and Singh (1981) and Gerrish (1981). In another study, Debnath (1987) and Roy *et al.*(1998), respectively, observed 13.95 to 245.10 per cent and -16.42 to 71.82 per cent heterobeltiosis. The cross combination (CM 151×CM 150) showed the most desirable value for heterosis for maturity traits. For green ear traits, 1025×CM 150 and BQPM-4×BAUIM-2 showed the most desirable value of heterosis for number and weight of green ears respectively. For green fodder yield and dry weight, BAUIM-1×BAUIM-2 revealed the highest magnitude of heterosis. For pericarp thickness, BQPM-2×HKI 193-1 revealed the most desirable value of heterosis. However for quality parameters, BQPM-2×BAUIM-2 exhibited the highest magnitude of economic heterosis for calcium, crude fibre, dry ash and reducing sugar contents while for iron and phosphorus contents, BAUIM-4×HKI 163 exhibited the most desirable value of heterosis. Izhar T and Chakraborty M (2013).

Therefore these promising crosses were identified as overall high general combiners and these could be utilized for development of either the synthetic varieties or an elite breeding population by allowing thorough mixing among them to achieve new genetic recombination and then subjecting the resultant population to recurrent selection.

In the second phase of the experiment of baby corn for fodder purpose, the analysis of variance to test the significance of difference among the genotypes revealed highly significant differences for all the traits like baby corn yield and quality attributes such as moisture, calcium, iron, phosphorus, reducing sugar, crude fibre and dry ash contents. Genetic variability for baby corn yield components has been reported by Tiwari and Verma (1999) and for various quality parameters by Shobha *et al.* (2010).

Chemical composition of maize genotypes for *per se* performance at baby corn stage is presented in table 6. The moisture content of the genotypes ranged from 5.32 % (HKI 193-1) to 7.35 % (BQPM-4). This was supported by Yodpet (1979). The cross mean ranged from 6.13 % (BAUIM-3 x CM 150) to 7.40 % (BAUIM-4 x K-1105) for moisture content. The calcium content in the genotypes varied from 14.23 mg (CM 152) to 15.10 mg (CML 161) followed by BAUIM-4 and BQPM-4. The cross mean for calcium content ranged from 14.98 mg (CM 152 x BAUIM-2) to 16.61 mg (BQPM-2 x HKI 163). The mean for iron content varied from 2.52 mg (BQPM-2) to 1.99 mg (CM 150) followed by BQPM-2 and BQPM-4. This finding is in accordance with the iron content of 2.3 mg as reported by Gopalan *et al.* (1971).

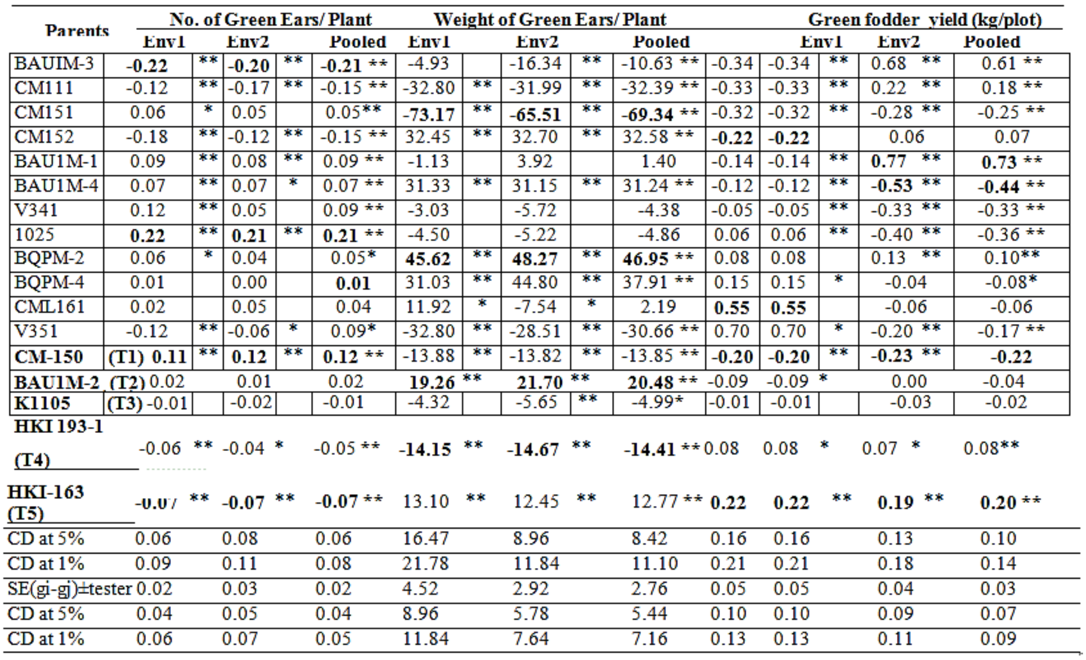
The cross mean ranged from 2.21 mg (BAUIM-1 x CM 150) to 2.75 mg (BQPM-2 x BAUIM-2) for iron content. BAUIM-3 and V 351 were at par with the check BVM-2 for phosphorus content varying from162.67 mg (1025) to 180.67 mg (HKI 193-1). Similar findings were reported by (Anon., 1998). The cross mean ranged from 144.00 mg (BQPM-2 x HKI 163) to 191.67 mg (CM 111 x K-1105) for phosphorus content. For total soluble sugar content, CM 111, BAUIM-4, BQPM-4 and BAUIM-2 were found to be at par with the check BVM-2 with the range varying from 0.07 % (1025) to 0.12 % (BQPM-4). This was in conformity with the findings of Ranhotra (1985). The cross mean varied from 0.10 % (CM 152 x BAUIM-2) to 0.14 % (BAUIM-4 x CM 150) for total soluble sugar content. The variability observed in chemical composition is due to genetic and environmental factors which includes time of harvesting, gap in estimating the moisture, sugar which influences the decrease in moisture, conversation of sugar to starch, type and place of storage etc. The crude fibre content of the parental lines ranged from 1.98 % (CM 150) to 2.18 % (BQPM-4). Crude fiber content of different maize genotypes are in agreement with the values reported by Cortez and Wild-Altamirano (1972). The cross mean varied from 2.04 mg (CM 152 x BAUIM-2) to 2.34 mg (BQPM-2 x BAUIM-2). Relatively more ash content was found in BQPM-2 (1.62 %) followed by 1023 (1.51 %) and V 341 (1.39 %).This was in accordance with the findings of Asha kawatra and Salil Sehgal (2007), where they reported 1.34% ash content for baby corn genotypes. The cross mean varied from 1.32 % (BAUIM-1 x CM 150) to 1.59 % (BQPM-2 x K-1105). The variability observed in chemical composition is due to genetic and environmental factors. Thus for the evaluation of attributes of high yielding maize genotypes along with high nutritional value to meet the international demand, sufficient genetic variability available in the material under study may be exploited. However for baby corn yield, the parental mean ranged from 73.67 q/ha (CM 152) to 95.48 q/ha (BAUIM-4). BAUIM-4 (95.48 q/ha) and BQPM-4 (94.97 q/ha) were found to be significantly superior to the check Suwan. The cross mean ranged from 92.81 q/ha (CM- 111 × K-1105) to 130.07 q/ha (BQPM-2 × BAUIM-2) followed by CM152× CM 150 (126.66 q/ha), BAUIM-1× BAUIM-2 (127.19 q/ha) and BQPM-2× 193-1 (125.16 q/ha). Similar variations for baby corn yield were reported by Ramachandrappa *et al.* (2004).

Therefore these promising crosses were identified as overall high general combiners and these could be utilized for development of either the synthetic varieties or an elite breeding population for development of good fodder type varieties by allowing thorough mixing among them to achieve new genetic recombination and then subjecting the resultant population to recurrent selection.

IV. ACKNOWLEDGEMENTS

The work has been carried out in Ph.D. programme under the financial support of Department of Science and Technology, Govt. of India for professional fellowship through INSPIRE programme.

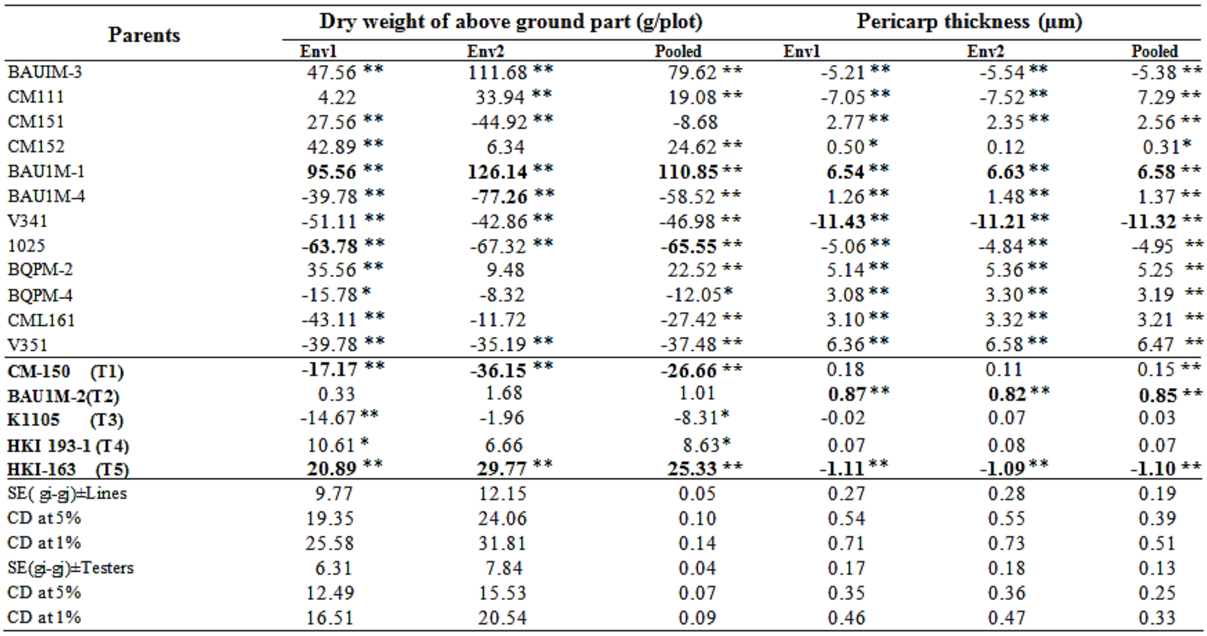
Table.1 GCA effects of parents for No.of Green Ears/ Plant, Weight of Green Ears/ Plant and Green fodder yield of green ear



Parents	No. of Green Ears/ Plant					Weight of Green Ears/ Plant						Green fodder yield (kg/plot)			
	Env1		Env2		Pooled	Env1		Env2		Pooled		Env1		Env2	Pooled
BAUIM-3	**-0.22**	**	**-0.20**	**	**-0.21** **	-4.93		-16.34	**	-10.63 **	-0.34	-0.34	**	0.68 **	0.61 **
CM111	-0.12	**	-0.17	**	-0.15 **	-32.80	**	-31.99	**	-32.39 **	-0.33	-0.33	**	0.22 **	0.18 **
CM151	0.06	*	0.05		0.05**	**-73.17**	**	**-65.51**	**	**-69.34** **	-0.32	-0.32	**	-0.28 **	-0.25 **
CM152	-0.18	**	-0.12	**	-0.15 **	32.45	**	32.70	**	32.58 **	**-0.22**	**-0.22**		0.06	0.07
BAU1M-1	0.09	**	0.08	**	0.09 **	-1.13		3.92		1.40	-0.14	-0.14	**	**0.77** **	**0.73** **
BAU1M-4	0.07	**	0.07	*	0.07 **	31.33	**	31.15	**	31.24 **	-0.12	-0.12	**	**-0.53** **	**-0.44** **
V341	0.12	**	0.05		0.09 **	-3.03		-5.72		-4.38	-0.05	-0.05	**	-0.33 **	-0.33 **
1025	**0.22**	**	**0.21**	**	**0.21** **	-4.50		-5.22		-4.86	0.06	0.06	**	-0.40 **	-0.36 **
BQPM-2	0.06	*	0.04		0.05*	**45.62**	**	**48.27**	**	**46.95** **	0.08	0.08		0.13 **	0.10**
BQPM-4	0.01		0.00		**0.01**	31.03	**	44.80	**	37.91 **	0.15	0.15	*	-0.04	-0.08*
CML161	0.02		0.05		0.04	11.92	*	-7.54	*	2.19	**0.55**	**0.55**		-0.06	-0.06
V351	-0.12	**	-0.06	*	0.09*	-32.80	**	-28.51	**	-30.66 **	0.70	0.70	*	-0.20 **	-0.17 **
CM-150	**(T1) 0.11**	**	**0.12**	**	**0.12** **	-13.88	**	-13.82	**	-13.85 **	**-0.20**	**-0.20**	**	**-0.23** **	**-0.22**
BAU1M-2	**(T2)** 0.02		0.01		0.02	**19.26**	**	**21.70**	**	**20.48** **	-0.09	-0.09	*	0.00	-0.04
K1105	**(T3)** -0.01		-0.02		-0.01	-4.32		-5.65	**	-4.99*	-0.01	-0.01		-0.03	-0.02
HKI 193-1 (T4)	-0.06	**	-0.04	*	-0.05 **	**-14.15**	**	**-14.67**	**	**-14.41** **	0.08	0.08	*	0.07 *	0.08**
HKI-163 (T5)	-0.07	**	**-0.07**	**	**-0.07** **	13.10	**	12.45	**	12.77 **	**0.22**	**0.22**	**	**0.19** **	**0.20** **
CD at 5%	0.06		0.08		0.06	16.47		8.96		8.42	0.16	0.16		0.13	0.10
CD at 1%	0.09		0.11		0.08	21.78		11.84		11.10	0.21	0.21		0.18	0.14
SE(gi-gj)±tester	0.02		0.03		0.02	4.52		2.92		2.76	0.05	0.05		0.04	0.03
CD at 5%	0.04		0.05		0.04	8.96		5.78		5.44	0.10	0.10		0.09	0.07
CD at 1%	0.06		0.07		0.05	11.84		7.64		7.16	0.13	0.13		0.11	0.09

*, ** = Significant at P = 0.05 and P = 0.01 respectively.,Maximum and minimum values in Bold figure

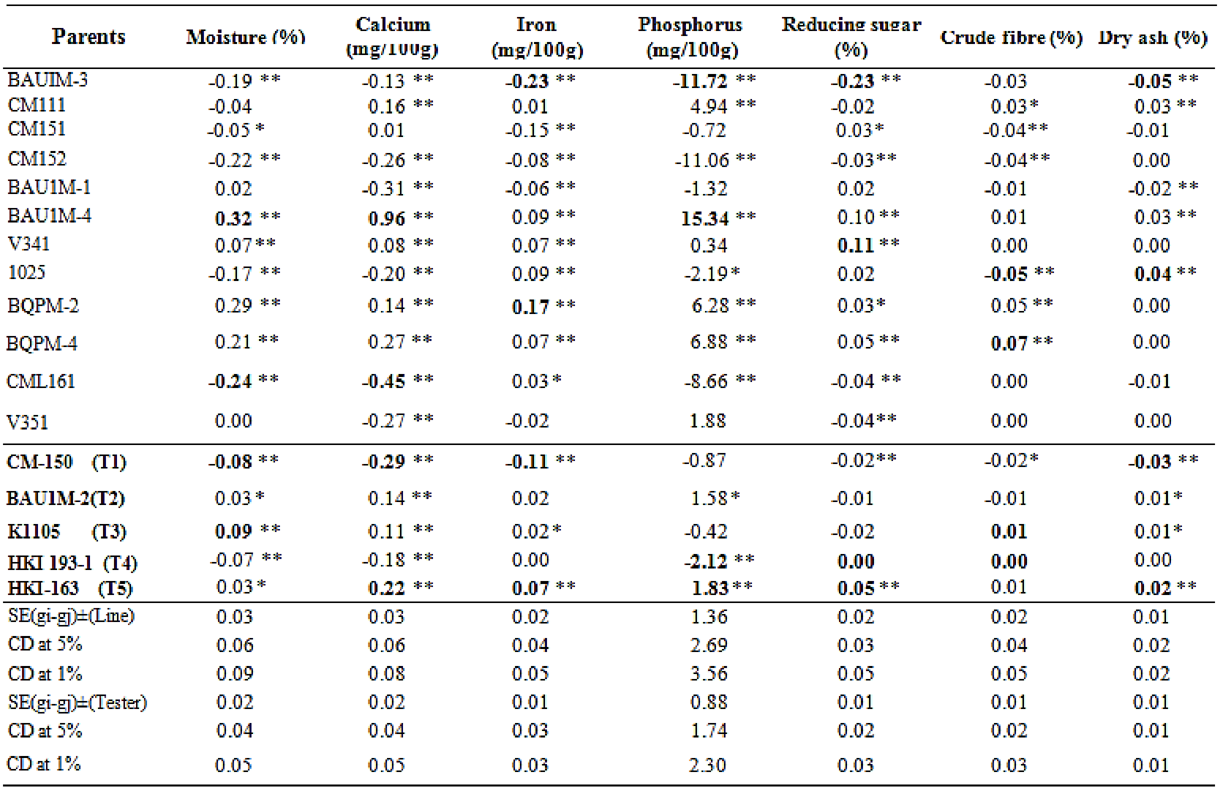
Table.2 Continued GCA effects of parents for Dry weight of above ground part and Pericarp thickness of green ear



Parents	Dry weight of above ground part (g/plot)			Pericarp thickness (µm)		
	Env1	Env2	Pooled	Env1	Env2	Pooled
BAUIM-3	47.56 **	111.68 **	79.62 **	-5.21 **	-5.54 **	-5.38 **
CM111	4.22	33.94 **	19.08 **	-7.05 **	-7.52 **	7.29 **
CM151	27.56 **	-44.92 **	-8.68	2.77 **	2.35 **	2.56 **
CM152	42.89 **	6.34	24.62 **	0.50 *	0.12	0.31*
BAU1M-1	**95.56** **	**126.14** **	**110.85** **	**6.54** **	**6.63** **	**6.58** **
BAU1M-4	-39.78 **	**-77.26** **	-58.52 **	1.26 **	1.48 **	1.37 **
V341	-51.11 **	-42.86 **	-46.98 **	**-11.43** **	**-11.21** **	**-11.32** **
1025	**-63.78** **	-67.32 **	**-65.55** **	-5.06 **	-4.84 **	-4.95 **
BQPM-2	35.56 **	9.48	22.52 **	5.14 **	5.36 **	5.25 **
BQPM-4	-15.78 *	-8.32	-12.05*	3.08 **	3.30 **	3.19 **
CML161	-43.11 **	-11.72	-27.42 **	3.10 **	3.32 **	3.21 **
V351	-39.78 **	-35.19 **	-37.48 **	6.36 **	6.58 **	6.47 **
CM-150 (T1)	**-17.17** **	**-36.15** **	**-26.66** **	0.18	0.11	0.15 **
BAU1M-2(T2)	0.33	1.68	1.01	**0.87** **	**0.82** **	**0.85** **
K1105 (T3)	-14.67 **	-1.96	-8.31*	-0.02	0.07	0.03
HKI 193-1 (T4)	10.61 *	6.66	8.63*	0.07	0.08	0.07
HKI-163 (T5)	**20.89** **	**29.77** **	**25.33** **	**-1.11** **	**-1.09** **	**-1.10** **
SE(gi-gj)±Lines	9.77	12.15	0.05	0.27	0.28	0.19
CD at5%	19.35	24.06	0.10	0.54	0.55	0.39
CD at1%	25.58	31.81	0.14	0.71	0.73	0.51
SE(gi-gj)±Testers	6.31	7.84	0.04	0.17	0.18	0.13
CD at5%	12.49	15.53	0.07	0.35	0.36	0.25
CD at1%	16.51	20.54	0.09	0.46	0.47	0.33

*, ** = Significant at P = 0.05 and P = 0.01 respectively.,Maximum and minimum values in Bold figure.

Table 3: General Combining Ability (GCA) effects of parents for Quality Parameters of Green ear



Parents	Moisture (%)	Calcium (mg/100g)	Iron (mg/100g)	Phosphorus (mg/100g)	Reducing sugar (%)	Crude fibre (%)	Dry ash (%)
BAUIM-3	-0.19 **	-0.13 **	**-0.23** **	**-11.72** **	**-0.23** **	-0.03	**-0.05** **
CM111	-0.04	0.16 **	0.01	4.94 **	-0.02	0.03*	0.03 **
CM151	-0.05 *	0.01	-0.15 **	-0.72	0.03*	-0.04**	-0.01
CM152	-0.22 **	-0.26 **	-0.08 **	-11.06 **	-0.03**	-0.04**	0.00
BAU1M-1	0.02	-0.31 **	-0.06 **	-1.32	0.02	-0.01	-0.02 **
BAU1M-4	**0.32** **	**0.96** **	0.09 **	**15.34** **	0.10 **	0.01	0.03 **
V341	0.07**	0.08 **	0.07 **	0.34	**0.11** **	0.00	0.00
1025	-0.17 **	-0.20 **	0.09 **	-2.19*	0.02	**-0.05** **	**0.04** **
BQPM-2	0.29 **	0.14 **	**0.17** **	6.28 **	0.03*	0.05 **	0.00
BQPM-4	0.21 **	0.27 **	0.07 **	6.88 **	0.05 **	**0.07** **	0.00
CML161	**-0.24** **	**-0.45** **	0.03 *	-8.66 **	-0.04 **	0.00	-0.01
V351	0.00	-0.27 **	-0.02	1.88	-0.04**	0.00	0.00
CM-150 (T1)	**-0.08** **	**-0.29** **	**-0.11** **	-0.87	-0.02**	-0.02*	**-0.03** **
BAU1M-2(T2)	0.03 *	0.14 **	0.02	1.58 *	-0.01	-0.01	0.01*
K1105 (T3)	**0.09** **	0.11 **	0.02 *	-0.42	-0.02	**0.01**	0.01*
HKI 193-1 (T4)	-0.07 **	-0.18 **	0.00	**-2.12** **	**0.00**	**0.00**	0.00
HKI-163 (T5)	0.03 *	**0.22** **	**0.07** **	**1.83** **	**0.05** **	0.01	**0.02** **
SE(gi-gj)±(Line)	0.03	0.03	0.02	1.36	0.02	0.02	0.01
CD at 5%	0.06	0.06	0.04	2.69	0.03	0.04	0.02
CD at 1%	0.09	0.08	0.05	3.56	0.05	0.05	0.02
SE(gi-gj)±(Tester)	0.02	0.02	0.01	0.88	0.01	0.01	0.01
CD at 5%	0.04	0.04	0.03	1.74	0.02	0.02	0.01
CD at 1%	0.05	0.05	0.03	2.30	0.03	0.03	0.01

*, ** = Significant at P = 0.05 and P = 0.01 respectively.,Maximum and minimum values in Bold figure.

Table.4 SCA effects of crosses for No. of Ears/ Plant, Weight of Green Ears/ Plant, green fodder yield, dry weight and pericarp thickness of green ear maize

Crosses	No. of Green Ears/ Plant			Weight of Green Ears/ Plant			Green fodder yield (kg/plot)			Dry weight of above ground part (g/plot)			Pericarp thickness (µm)		
	Env1	Env2	Pooled	Env1	Env2	Pooled	Env1	Env2	Pooled	Env1	Env2	Pooled	Env1	Env2	Pooled
CM111× K1105	-0.11**	0.04*	-0.03	17.11**	40.49**	28.80**	0.46**	0.52**	0.49**	78.00**	89.89**	83.94**	1.62**	1.63**	1.63**
BAU1M-4× HKI163	-0.22**	-0.09**	-0.16**	**134.83****	**132.65****	**133.74****	-0.07	-0.14**	-0.10**	86.44**	19.03**	52.74**	-7.33**	-7.36**	-7.35**
V341× BAU1M-2	**0.45****	0.21**	0.33**	9.85*	-19.85**	-5.00	0.00	-0.14**	-0.07	-31.67**	12.72**	-9.48	5.01**	5.06**	5.03**
V341× K1105	**0.45****	0.21**	**0.33****	9.85**	-19.85**	-5.00	0.00	-0.14**	-0.07	33.33**	-16.64**	8.34	-3.67**	-3.76**	-3.71**
BQPM-2× HKI 193-1	0.01**	0.09**	0.05	88.98**	81.18**	85.08**	0.59**	**0.83****	**0.71****	**104.72****	100.08**	**102.40****	9.65**	9.64**	9.65**
BQPM-2× HKI163	-0.06**	-0.12**	-0.09*	-29.99**	-31.72**	-30.86**	**-0.69****	**-0.68****	**-0.68****	-72.22**	-100.70**	-86.46**	-9.10**	-9.13**	-9.12**
BQPM-4× HKI 193-1	-0.01	0.04*	0.02	-48.74**	-80.35**	-64.55**	-0.37**	-0.32**	-0.35**	-60.61**	-48.79**	-54.70**	**-18.22****	**-18.23****	**-18.23****
SE-Sij-Skl ±	0.07	0.09	0.06	18.60	10.11	9.56	0.18	0.15	0.12	21.85	27.17	17.83	0.60	0.63	0.44
CD at 5%	0.15	0.18	0.13	36.84	20.03	18.83	0.35	0.30	0.24	43.26	53.81	35.12	1.20	1.24	0.86
CD at 1%	0.19	0.24	0.17	48.70	26.48	24.82	0.46	0.39	0.32	57.20	71.14	46.29	1.58	1.64	1.14
SE-Sij-Sik ±	0.07	0.15	0.11	29.99	16.31	15.42	0.28	0.24	0.19	35.23	43.81	28.75	0.97	1.01	0.71
CD at 5%	0.15	0.30	0.21	59.40	32.29	30.37	0.56	0.48	0.38	69.76	86.76	56.64	1.93	2.00	1.39
CD at 1%	0.19	0.39	0.27	78.53	42.69	40.03	0.75	0.63	0.51	92.23	114.71	74.65	2.55	2.64	1.84

*, ** = Significant at P = 0.05 and P = 0.01 respectively.,Maximum and minimum values in Bold fig ure.

Table.5 SCA effects of crosses for Quality parameters of Green Ear

Crosses	Moisture (%)	Calcium (mg/100g)	Iron (mg/100g)	Phosphorus (mg/100g)	Reducing sugar (%)	Crude fibre (%)	Dry ash (%)
BAU1M-4× K1105	**-0.30****	0.17**	-0.03	-11.84**	-0.11**	-0.08**	-0.01**
BQPM-2× BAU1M-2	**0.93****	**1.25****	**0.20****	20.22**	**0.21****	**0.15**	**0.13****
BQPM-4× BAU1M-2	-0.25**	0.00**	0.01	-3.04**	0.13	-0.05**	-0.02**
SE-Sij-Skl ±	0.07	0.07	0.05	3.04	0.04	0.04**	0.02
CD at 5%	0.14	0.14	0.09	6.02	0.08	0.08	0.04
CD at 1%	0.19	0.18	0.12	7.96	0.10	0.11	0.05
SE-Sij-Sik ±	0.12	0.11	0.07	4.91	0.06	0.07	0.03
CD at 5%	0.23	0.22	0.15	9.71	0.12	0.13	0.06
CD at 1%	0.31	0.29	0.19	12.84	0.16	0.18	0.08

*, ** = Significant at P = 0.05 and P = 0.01 respectively.,Maximum and minimum values in Bold figure.

Table 6: Mean performance of Parents

Parents	Moisture (%)	Calcium (mg/100g)	Iron (mg/100g)	Phosphorus (mg/100g)	Total soluble Sugar (%)	Crude fibre (%)	Dry ash (%)	Baby corn yield (q/ha)
BAUIM-3	5.97	14.59	2.20	167.67	0.10	2.06	**1.20**	78.65
CM111	5.42	14.48	2.16	168.67	0.11	2.00	1.22	80.61
CM151	5.37	14.44	2.13	168.33	0.08	2.03	1.21	74.69
CM152	6.47	**14.23**	2.10	173.67	0.08	2.03	1.21	**73.67**
BAUIM-1	5.82	14.41	2.31	172.67	0.10	2.06	1.37	85.38
BAUIM-4	6.27	14.96	2.44	176.33	0.11	2.15	1.36	**95.48**
V341	5.69	14.54	2.16	173.67	0.08	2.14	1.39	84.03
1025	6.96	14.31	2.17	**162.67**	**0.07**	2.03	1.51	75.05
BQPM-2	6.40	15.10	**2.52**	170.67	0.10	2.16	**1.62**	87.35
BQPM-4	**7.35**	14.96	2.39	173.67	**0.12**	**2.18**	1.36	94.97
CML161	6.22	**15.10**	2.31	172.00	0.08	2.13	1.38	82.20
V351	6.06	14.71	2.16	168.33	0.08	2.04	1.32	88.91
CM 150 (T1)	7.10	14.37	**1.99**	172.00	0.10	**1.98**	1.23	81.82
BAUIM-2(T2)	5.49	14.55	2.23	171.00	0.11	1.99	1.23	83.94
K1105 (T3)	5.48	14.28	2.22	167.00	0.08	2.05	1.25	83.83
193-1 (T4)	**5.32**	14.61	2.22	**180.67**	0.07	2.10	1.25	73.09
HK-163 (T5)	5.95	14.55	2.35	176.33	0.09	2.08	1.33	80.70
Mean	6.08	14.60	2.24	171.49	0.09	2.07	1.32	82.61
CHECKS								
BVM-2	6.41	15.10	2.40	176.33	0.12	2.17	1.42	90.86
SUWAN	6.47	15.16	2.39	165.67	0.11	2.10	1.28	94.31
Mean	6.44	15.13	2.5	171.00	0.11	2.1	1.36	92.58
SEm ±	0.03	0.05	0.01	2.35	0.00	0.03	0.02	3.28
CD at 5%	0.11	0.18	0.03	8.56	0.01	0.10	0.06	11.97
CD at 1%	0.08	0.14	0.03	6.50	0.01	0.08	0.04	9.09

Maximum and minimum values in Bold figure.

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