INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 5, No. 1, p. 29-36, 2014

RESEARCH PAPER OPEN ACCESS

Effect of spring and autumn sowing on morphological attributes of sweet corn genotypes

Farhat Yasmeen[1*], Naveed Iqbal Raja[1], Muzammil Hussain[2], Neelam Taj[1], Sunbal Khalil Chaudhari[1]

[1]*Department of Botany, PMAS Arid Agriculture University Rawalpindi, Pakistan.*

[2]*Crop Science Institute, NARC, Islamabad, Pakistan*

Key words: Sweet corn, morphological traits, seasonal effects, plant height, ear height.

http://dx.doi.org/10.12692/ijb/5.1.29-36 Article published on July 02, 2014

Abstract

Two field experiments were conducted at National Agriculture Research council Islamabad during 2012-2013 growing season. The 15 sweet corn varieties from diverse geographic origins were chosen to study the morphological traits such as days to maturity, mid node antocyanin, internode length, cob leaf length and width, leaves per plant, ear height, plant height,50% pollen shedding, tessel characters, 50% silk emergence and cob characters. Seed characteristics have also been recorded to have an analysis on yield to check the effect of sowing season. Results showed spring sowing was on average has better effect on sweet corn growth as compared to autumn season. Spring season has resulted better plant height and yield as compared to autumn season.

* **Corresponding Author:** Farhat Yasmeen ✉ msc_arid2007@yahoo.com

Introduction

Sweet corn is one of the most important vegetable crops in the United States. Corn is a worldwide commodity and crop. Most early Native American farmers of central and southern North America and throughout South America used corn. *Zea mays* L. ssp. *mays*, commonly referred to as maize or corn, belongs to the grass tribe Andropogoneae of the family Gramineae (Poaceae). The grasses originated 55-70 million years ago and subsequently diversified to include all the major cereal crop species in addition to nearly 10,000 nondomesticated relatives (Kellogg 2001; Bolot *et al.* 2009). mexicana (hereafter mexicana) and ssp. parviglumis (hereafter parviglumis) and ssp. huehuetenangensis that is endemic to a small region of western Guatemala. Parviglumis and mexicana are thought to have diverged ca. 60,000 years ago (Hanson *et al.* 1996, Ross-Ibarra *et al.* 2009). Sweet corn differs from dent corn by one recessive gene 'su' on 4th chromosome which prevents the conversion of part of sugars in to starch. It has been reported to be a mutant from field corn (Kempton, 1928; Linder storm, 1929; Smith, 1955).

Comparative morphological studies of maize (*Zea mays* L.) play an important role in the management of crop diversity. Morphological data provided the initial basis for taxonomic studies of maize (Sturte-vant, 1884) and have remained a mainstay of maize racial taxonomy to current times (Ortiz *et al.*, 2008). Morphological data also play an important role in the management of genetic resources that are conserved in ex situ gene-banks (Sanchez *et al*, 2000; Bioversity International, 2007). Improvement of sweet corn yields, while retaining quality is one of the major challenges facing the sweet corn breeders (Hunsperger and Davis, 1987). Morphological characters are important criterion for determination of germplasm quality. So an effort was made to study the germplasm for different morphological characters in two growing seasons and to identify superior sweet corn genotypes and also the suitable season for the growth of sweet corn for getting maximum yield.

Materials and methods

Site specification

The 15 lines of sweet corn (*Zea mays* L) from different geographical location, investigated for the study of morphological traits. Therefore, two field experiments were conducted at National Agriculture Research Council Islamabad Pakistan.

Material Selection

The 15 sweet corn varieties from diverse geographic origins were obtained from National Agriculture Research Council (NARC) Islamabad Pakistan having good seed size and texture and which seems very healthy (Table 1).

Planting and Spacing

Sweet corn seeds were planted on February 15, 2012 and July 16, 2012 in spring and autumn sowing, respectively. Each line was sown 4 m in length, with 75 cm inter-row spacing and 20cm intra-spacing. Urea and potash were used as fertilizers. Weeds were removed manually in all plots. The corn cultivation was rainfed but, the field was irrigated time to time to avoide any abiotic stress.

Crop Measurements

For each line days to maturity, mid node anthocyanin, internode length, leaf length, leaf width, plant height, ear height leaves per plant, 50 % pollen shedding, tassel length, tassel stalk length, number of tassel branches, pollen color, 50% silk emergence, silk color and number of ears per plant were recorded.

Statistical Analyses

The data collected in this study was subjected to analysis of variance (ANOVA) and the LS means was used to compare means of traits ($p< 0.05$). In addition, correlation coefficients among traits were also determined.

Results and discussions

Morphological Traits of sweet corn

Morphological traits description is an important requirement for successful and competent utilization of germplasm collection in breeding program. There

is a high level of morphological diversity for most of the traits observed in autumn and spring sowing, which may be useful for future breeding endeavors.

Days to Maturity

The rate of corn growth between plant emergence and tassel emergence most significantly affects the total time required for maturity and establishes the date it will be ready for harvest. These stages of growth can range from 45 days to 75 days. The days to maturity was not significantly affected by cultivars and sowing date. The sweet corn cultivars in both seasons spent almost same time in attaining maturity. The cultivar 1, 3 and 9 had taken bit higher time in becoming mature in autumn season as compared to spring while cultivars 4, 6 and 13 have spent more time in becoming mature in spring season. So cultivar 1,3 and 9 are better to be grown in spring season while cultivar 4, 6 and 13 should be grown in autumn season so that better output can be attained.

Table 1. List of sweet corn lines used in this study.

S. No.	Name of lines	ACCID	BANKACCS	Altitude	GID	Primeria
1	SONOGP7	380	380	440	243598	DULNOR
2	SONO57	633	633	0	243738	DULNOR9
3	MICH15	1903	1903	1610	244636	MDULCE
4	JALI300	6945	6945	1400	248273	MDULCE
5	JALI304	6949	6949	1700	206141	MDULLE
6	SINA34	7141	7141	500	248390	DULNOR
7	SINA40	7147	7147	200	248395	DULNOR8
8	SINA43	7150	7150	300	248397	MDULCE
9	SONO85	7265	7265	280	248473	DULNOR
10	SONO159	7335	7335	600	210470	DULNOR
11	SONO171	7346	7346	280	210590	DULNOR
12	CHIHI27	7931	7931	1470	249008	MDULCE
13	SINA33	8002	8002	500	249065	DULNOR8
14	SINA87	8004	8004	370	217250	DULNOR8
15	SINA88	8005	8005	370	249069	DULNOR8

Table 2. Morphological Traits of sweet corn in spring season (March).

Genotype	Days to maturity	Mid node anthocyn	Internode length	Leaf colour	Cob length	leaf Cob width	leaf Leaves/ plant	Plant height	Ear Height
1	105	1	17.8	Dark Green	100.2	6.9	8	174.4	73
2	100	5	18	Dark Green	108.6	8.3	8	172	83.8
3	102	1	19.2	Dark Green	95.8	7.5	10	194.6	114.2
4	109	1	18.8	Dark Green	100.4	8,4	7	167.8	63.4
5	95	A	17.6	Dark Green	109	6.2	10	174.4	71.2
6	105	3	17.6	Dark Green	123.6	7.2	11	198.4	100.6
7	103	A	18.6	Dark Green	102.5	7,5	13	219.6	121.6
8	100	A	18.6	Dark Green	113.3	7.5	9	210	122.2
9	104	A	17.2	Dark Green	109	8.2	9	172.8	71.4
10	103	A	20.4	Dark Green	103.6	7.6	8	175.4	56
11	100	2	18	Dark Green	114.8	8.5	11	173.8	68.6
12	95	1	19.5	Dark Green	108.8	8.6	11	179.8	40.4
13	108	A	22.3	Dark Green	122.8	8.2	11	207.8	97.4
14	102	A	19	Dark Green	125	10	14	207.8	17.4
15	105	A	17.8	Dark Green	114.3	9.8	11	205.2	105.6

Scale: 1: very very light purple 2: very light purple 3: light purple 4: dark purple 5: very dark purple A: absent.

Midnode Anthocyanin

Anthocyanin is water soluble vacuolar pigment belongs to parent class of molecules called flavonoides. The midnode anthocyanin is also an important character acting as sunscreen protecting cells from high light damage by absorbing blue green and ultraviolet light thereby protecting the tissues from photoinhibition. This character has been

observed in cultivars 1, 2, 3,4, 6, 11 and 12 in both seasons whereas remaining cultivars showed no anthocyanin formation at midnodes as is clearly shown in graphic presentation which provide these cultivars an extra benefit in stress tolerance.

Table 3. Morphological Traits of sweet corn in Autumn season (JULY).

Genotype	Days to maturity	Mid node anthocyn	Internode length	Leaf colour	Cob leaf length	Cob leaf width	Leaves/ plant	Plant height	Ear Height
1	115	1	19.5	Dark Green	91.7	8.2	8	102	50
2	105	5	21	Dark Green	94.3	7.3	8	150	59
3	116	1	20	Dark Green	103.7	8.5	10	200	102
4	100	1	16.5	Dark Green	99.7	8.2	7	170	75
5	105	A	21.75	Dark Green	101.3	8	10	165	70
6	90	3	17.75	Dark Green	115.3	7.5	11	180	79
7	102	A	17.75	Dark Green	117.3	7.8	13	201	100
8	92	A	18.5	Dark Green	117.3	7.8	9	215	120
9	124	A	22.75	Dark Green	116.7	7.3	9	178	129
10	100	A	19	Dark Green	73.3	6.3	8	95	45
11	106	2	20	Dark Green	100.7	7.8	11	165	69
12	102	1	22.25	Dark Green	75	7	11	99	49
13	100	A	18.25	Dark Green	109	7.7	11	193	91
14	106	A	20	Dark Green	105.3	9	14	190	85
15	115	A	22.25	Dark Green	106	7.7	11	191	83

Scale: 1: very very light purple 2: very light purple 3: light purple 4: dark purple 5: very dark purple A: absent.

Table 4. Morphological Traits of sweet corn in Spring season (March).

Genotype	50% Silk emergence	Silk colour	50% Pollen shedding	Tassel length	Tssel stalk length	NO. Lateral branches	Number ears/ plant	Pollen colour
1	62	Light pink	55	53.2	18	13.2	2	Yellow
2	68	pink	57	56.2	16	17.2	1	Yellow
3	90	white	85	47.6	14	17.4	1	Yellow
4	74	Cream colour	63	51.4	19	19.2	1	Yellow
5	64	white	63	51	17	27	2	Yellow
6	84	white	75	60.8	22	28	1	Yellow
7	88	white	80	56	18	23.8	1	Yellow
8	90	pink	77	47	19	23.2	1	Yellow
9	61	Light pink	56	50.8	15	17.4	1	Yellow
10	74	white	55	46.6	11	18.2	1	Yellow
11	69	mehron	62	46.4	13	18.2	2	Yellow
12	70	Light pink	62	54.2	9	19.8	1	Yellow
13	84	Light pink	75	58.6	12	13.8	1	Yellow
14	89	pink	78	35	15	16.4	1	Yellow
15	92	pink	79	39.4	13	15.2	1	Yellow

Leaf Characteristics

Leaf color is also an important trait which has been shown consistent in both season of sowing. Leaf morphology and anatomy during vegetative phase change was compared in bluegrass, rice, and maize. Maize juvenile leaves are coated with epicuticular wax, lack specialized cells, such as trichomes and bulliform cells, and epidermal cell walls stain a uniform purple color. Adult maize leaves are pubescent, lack epicuticular waxes, and have crenulated epidermal cell walls that stain purple and blue. Cob leaf length and width is important as they determine the ability of plant to capture sunlight for photosynthesis. Cob leaf length was significantly higher in cultivars 1, 2, 10, 11, 13 and 14 in spring season indicating high photosynthetic efficiency as compared to autumn season while cultivar 3, 7, 8 and 9 showed best leaf length in autumn season. So

cultivars 1, 2, 10, 11, 13 and 14 should be categorized as spring season cultivars while cultivars 3, 7, 8 and 9 as autumn season cultivars. Cob leaf width was also significantly affected by the growing season. Cob leaf width increased significantly in cultivars 2, 9, 12, 14 and 15 as compared to autumn season while cultivar 1, 2 and 5 showed increase in width in autumn season.

Table 5. Morphological Traits of sweet corn in autumn season (JULY).

Genotype	50% Silk emergence	Silk colour	50% Pollen shedding	Tassel length	Tssel stalk length	NO. Lateral branches	Number ears/ plant	Pollen colour
1	62	Light pink	55	43.7	13.3	9	1	Yellow
2	68	pink	60	39	13	11.7	1	Yellow
3	90	white	88	45.7	13	9.7	1	Yellow
4	74	Cream color	60	46	13.3	7.7	1	Yellow
5	64	white	60	45.7	13.3	9.7	1	Yellow
6	84	white	79	49.7	15	11.7	1	Yellow
7	88	white	85	42.7	16.3	14.3	1	Yellow
8	90	pink	70	41.7	13.3	13	1	Yellow
9	61	Light pink	63	42.7	14.7	14.3	1	Yellow
10	74	white	57	40.7	13.7	8.3	1	Yellow
11	69	mehron	65	48.7	16	10.3	1	Yellow
12	70	Light pink	59	49.7	16	9	1	Yellow
13	84	Light pink	70	48	13.7	9.7	1	Yellow
14	89	pink	80	49.3	17.3	17	1	Yellow
15	92	pink	82	46.7	17	16.3	1	Yellow

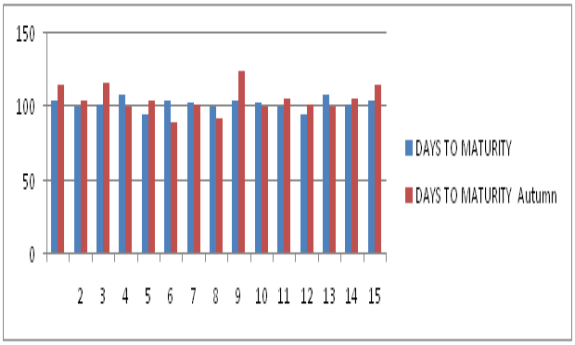

Fig. 1. Comparison of Days to Maturity in Both Seasons of Cultivation.

Numbers of leaves per plant were same in both growing seasons in all cultivars. Very few deviations were found in some cultivars but that was negligible.

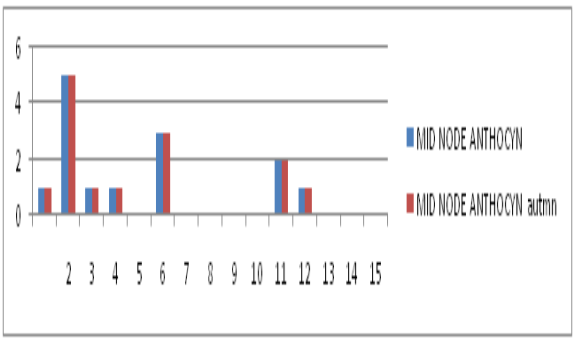

Fig. 2. Comparison of Mid Node Anthocyanin in Both Seasons of Cultivation.

Plant Height

The maize plant is often 2.5 m (meters) (8 ft) in height, though some natural strains can grow 12 m (40 ft). The plant height was significantly affected by cultivars and sowing date the sweet corn cultivars have higher plant height in spring season as compared to autumn season. Cellular growth appears to be the most sensitive response to growing season. Significant height difference was observed in line number 1, 11 and 13 while in case of line number 3, 4 and 9 no significant difference was observed. So the line number 3, 4 and 9 are best to grow in both seasons.

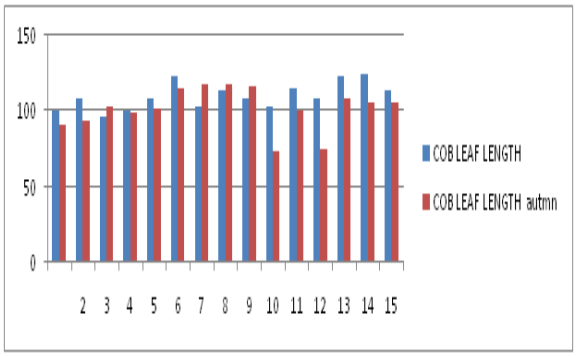

Fig. 3. Comparison of Cob Leaf Length in Both Seasons of Cultivation.

Ear Height

Ears develop above a few of the leaves in the midsection of the plant, between the stem and leaf sheath, elongating by ⌈3 mm/day, to a length of 18 cm (7 in) (60 cm/24 in being the maximum observed in the subspecies. They are female inflorescence, tightly enveloped by several layers of ear leaves commonly called husks. Certain varieties of maize have been bred to produce many additional developed ears. Ear height is also an important morphological trait which has contribution in yield. In cultivars 1, 2, 6, 7 and 15 ear height was significantly high in spring season as compared to autumn season while in cultivars 9 and 14 ear height was significantly high in autumn seasons however cultivars 5, 8 and 11 exhibited no significant difference in ear height. In these cultivars ear height was found same in both growing seasons. So cultivar 5, 8 and 11 can be grown in both seasons as season is not contributing negative impact on yield.

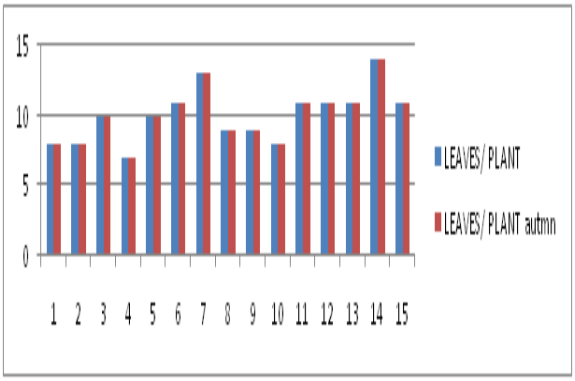

Fig. 4. Comparison of Cob Leaf Width in Both Seasons of Cultivation.

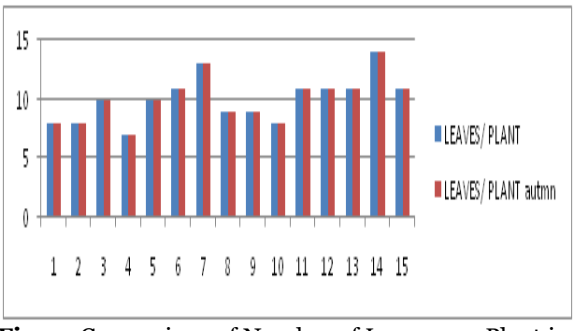

Fig. 5. Comparison of Number of Leaves per Plant in Both Seasons of Cultivation.

Silk Characteristics

Elongated stigmas, called silks, emerge from the whorl of husk leaves at the end of the ear. They are often pale yellow and 7 in (178 mm) in length, like tufts of hair in appearance. At the end of each is a carpel, which may develop into a "kernel" if fertilized by a pollen grain. During pollination, pollen shed from the anthers germinates on the silk and travels through the growing pollen tube to the ovule. Silk of sweet corn is also very important as it has the ability to capture pollens and can give better yield so its emergence and dazzling colors help in pollination. Silk emergence was observed same in both growing seasons which indicate that growing season is independent of silk emergence while silk color was very diverse in all cultivars. White to mehron colors have been observed in all cultivars of sweet corn.

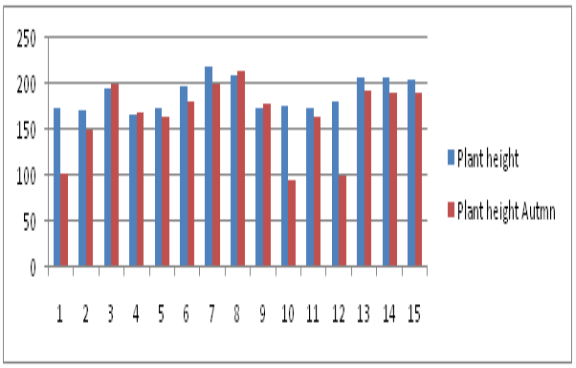

Fig. 6. Comparison of Plant Height in Both Seasons of Cultivation.

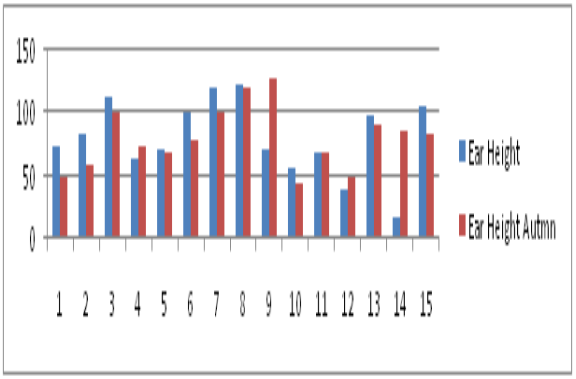

Fig. 7. Comparison of Ear Height in Both Seasons of Cultivation.

Tassel and pollen characteristics

The apex of the stem ends in the tassel, an inflorescence of male flowers. When the tassel is mature and conditions are suitably warm and dry, anthers on the tassel dehisce and release pollen. Tassel branches bear an ordered arrangement of small flower-producing branches called spikelets. Two spikelets are initiated at each branch point, and each spikelet produces two functional florets--a

pedicellate floret borne on a moderate stem and a sessile floret borne on a short stem. Anthers, forced out of the flower at anthesis, dangle downward and shed pollen Pollen shedding is important as silk appears pollen has to be shed to attain maximum yield. . Maize pollen is anemophilous (dispersed by wind), and because of its large settling velocity, most pollen falls within a few meters of the tassel. In both seasons pollen shedding was same. Very few cultivars showed change in pollen shedding in both seasons that is almost negligible.

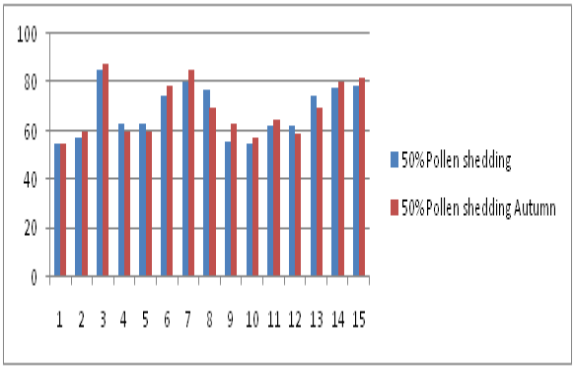

Fig. 8. Comparison of 50% Pollen Shedding in Both Seasons of Cultivation.

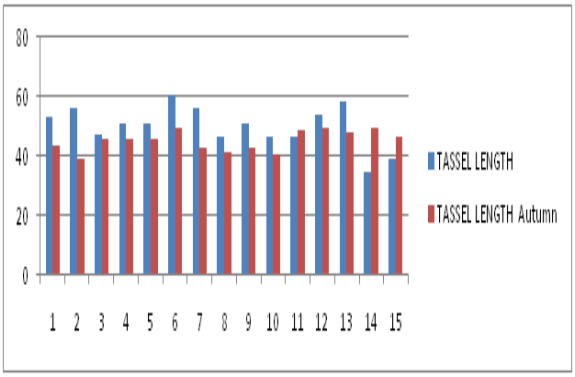

Fig. 9. Comparison of Tassel Length in Both Seasons of Cultivation.

Tassel length is dependent on growing seasons. Higher tassel length is indication of more pollen production which increases chances of maximum pollination. Cultivars 1, 2, 6, 7 and 13 showed significantly high tassel length in spring season as compared to autumn season while cultivars 14 and 15 showed increased length in autumn season. Cultivars 3 and 11 showed no difference in length in both seasons so these can be grown in both seasons of cultivation.

Tassel stalk length also showed significant variation in both growing seasons. In cultivars 1, 4, 6 and 8 showed increased stalk length in spring as compared to autumn season while cultivars 10, 11, 12, 14 and 15 exhibited increase in stalk length in autumn season.

Number of lateral tassel branches also showed significant variation in different growing seasons. High numbers of lateral branches were observed in cultivars 4, 5, 6, 7, 8 and12 in spring season as compared to autumn season while cultivars 14 and 15 showed no change in number od lateral branches in both seasons.

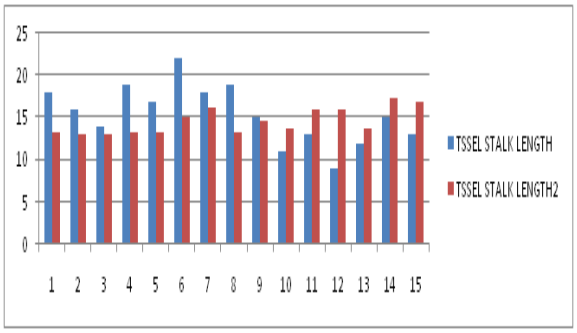

Fig. 10. Comparison of Tassel Stalk length in both Seasons of Cultivation.

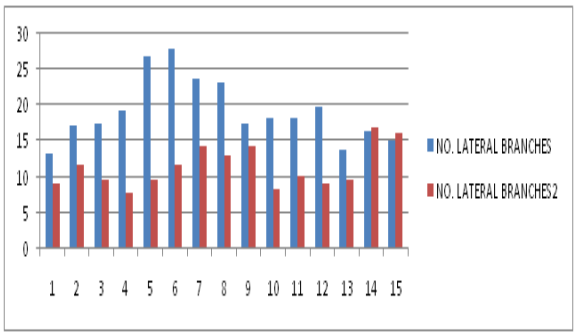

Fig. 11. Comparison of number of lateral branches in both seasons of cultivation.

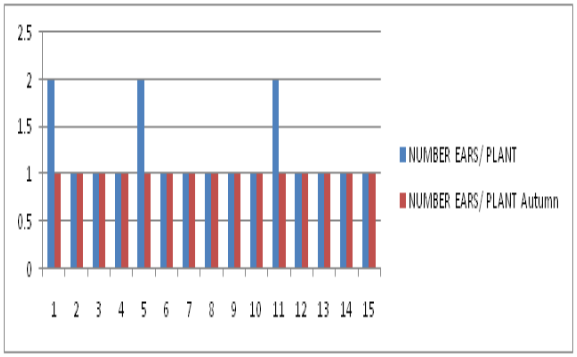

Fig. 12. Comparison of Number of ears per plant in both seasons of cultivation.

Number of ears per plant is very important as ears number determine the yield. The cultivars having more ears will be considered best to be sown. Cultivars 1, 5 and 11 showed more yield in spring as compared to other cultivars. So these cultivars should be sown in spring season for attaining good output in the form of yield.

References

Bioversity International. 2007. Guidelines for the development of crop descriptor lists. Bioversity Tech Bull Series. Bioversity international, Rome, Italy. XII

Bolot S, Abrouk M, Masood Quraishi U, Stein N, Messing J, Feuillet C, Salse J. 2009. The 'inner circle' of the cereal genomes. Current opinion in plant biology **12,** 119–125. http://dx.doi.org/10.1016/j.pbi.2008.10.011

Hanson MA, Gaut BS, Stec AO, Fuerstenberg SI, Goodman MM. 1996. Evolution of anthocyanin biosynthesis in maize kernels: the role of regulatory and enzymatic loci. Genetics **143,** 1395–1407.

Hunsperger MH, Davis DW. 1987. Effects of the sugary-1 locus on plant and ear traits in corn. Crop Science **27,** 1173-1176. http://dx.doi.org/10.2135/cropsci1987.0011183X002700060017x

Kellogg EA. 2001. Evolutionary history of the grasses. Plant Physiology **125,** 1198–1205. http://dx.doi.org/101104/pp.125.3.1198

Kempton 1928. Maize and man. J. of Heredity **17,** 35.

Linderstrom, EW. 1929. Linkage of qualitative and quantitative genes in maize. The American naturalist **63,** 317-327.

Ortiz R, Crossa, J, Franco J, Sevilla R, Burgueno J. 2008. Classification of Peruvian highland maize races using plant traits. Genetic Resources and Crop Evolution **55,** 151-162. http://dx.doi.org/10.1007/s10722-007-9224-7

Ross-Ibarra J, Tenaillon MI, Gaut BS. 2009 Historical divergence and gene flow in the genus Zea. Genetics **181,** 1399–1413. http://dx.doi.org/10.1534/genetics.108.097238

Sanchez JJ, Goodman MM, Stuber CW. 2000. Isozymatic and morphological diversity in the races of maize in Mexico. Economic Botany **54,** 43-59.

Smith GM. 1955. Sweetcorn: Corn and corn improvement. Academic Press, New York.

Sturtevant EL. 1884. Maize: An attempt at classification. Democrat and Chronicle Print Rochester, NY.