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DEVELOPMENT OF TILLERS IN MAIZE (*ZEA MAYS* L.) HYBRIDS : A REVIEW

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Abstract

Maize is an important cereal crop, which was evolved from its wild relative *Teosinte* to the modern day maize cultivars. Tillering is a distinct character of crops belonging to grass family *Poaceae* but maize was selected by generations for non tillering plant architecture favouring high planting density. Over the years, tillers have become very uncommon in maize though, under extremely favourable condition development of tillers is triggered. Many studies have revealed that these tillers has no negative impact on maize yield rather, this could indicate ideal growing condition and also could prove beneficial when the main stem is damaged. Tiller initiation and its mechanisms are not extensively studied apart from the two genes identified *viz., tb*1 and *ba*1. As the tillers produce malformed cobs, a proper genetic break up of tillering in maize could be more beneficial in plant breeding to produce productive tillers which in turn can boost the current yield potential.

Key words : *Poaceae*, tillering, productive tillers, planting density.

Introduction

Maize is an important cereal crop in Poaceae family and plays an vital role in the global food production. The modern day maize has been evolved from its ancestor belonging to teosinte, where along the selection pressure non tillering type of cultivars were selected by mankind. Tillering in cereal crops such as, rice is a common phenomenon and was found to have strong correlation with grain yield (Doust, 2007) whereas, maize and other related can produce tillers under ideal growing conditions (Moulia *et al*., 1999; Doust, 2007). Tillers are branches of a crop arising from the nodes lying below the soil surface and they develop individual root system but retain a vascular connection with main branch (Rosenquist, 1941; Leonard and Martin, 1963; Akman, 2002). Development of tillers in corn is mainly dependant on plant density, available nutrients and moisture content (Park *et al*., 1989). Two genes have been identified responsible for the lateral growth namely *teosinte branched* (tb1) and epistatic gene to tb1 called *barren stalk* (ba1). These genes seems to enhance lateral branching and promote apical dominance (Doebley and Hubbard, 1997; Ritter *et al*., 2002).

Tillering in maize is nearly a rare phenomenon in the maize cultivating regions of India however, farmers tend to believe that tillering could adversely affect the kernel yield of the main branch, thus termed them as "suckers", which is scientifically not correct.

Development of tillers in maize hybrids at experimental site

An experiment was conducted by Raj *et al*. (2019) using twenty three maize hybrids in three different locations namely, Viluppuram (E1), Trivandrum (E2) and Nagercoil (E3). Viluppuram is a major maize growing district of Tamil Nadu, India whereas; in Nagercoil maize cultivation was discontinued many decades before. Trivandrum was entirely new for maize cultivation and the hybrids were evaluated for their various growth parameters. The location description along with the soil fertility status is given in Table 1.

Tillering in twenty two maize hybrids were observed at Nagercoil, India whereas; no tillering was observed in other two locations (fig. 1). According to the

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Fig. 1 : Development of tillers in Nagercoil - E3.

Fig. 2 : Malformed cob on tiller.

environmental indices, Nagercoil was identified as the best performing location for yield per plant followed by Trivandrum and Viluppuram (table 2). Despite of tillering, the hybrid performance was enhanced at E3 due to ideal growing conditions during the duration of maize crop. The growing conditions included sandy clay loam soil whose pH and EC ranged from 7.4 to 6.6 and 0.34 to

Table 1: Particulars of three environments.

Particulars	E1	E2	E3
Location	Melkaranai, Villupuram Dt, Tamilnadu	Vithura, Trivandrum Dt, Kerala	Nagercoil, Kanyakumari Dt, Tamilnadu
Latitude	13.0939°N	8.6741°N	8.2383°N
Longitude	80.2924°E	77.0794°E	77.2727°E
Season	June 2017	June 2017	July 2017
Soil type	Sandy clay loam	Sandy clay loam	Sandy clay loam
Soil pH	7.4	6.3	6.6
EC	0.34	0.14	0.14
Soil status			
N	Low	Low	Low
P	Medium	High	**High**
K	High	Low	Medium
Fe	Sufficient	Sufficient	**Sufficient**
Mn	Low	Low	**Sufficient**
Zn	Low	Low	**Sufficient**
Cu	Sufficient	Sufficient	**Sufficient**
Climate			
Avg. temp (°C)	30.7	26.7	27.9
Avg. rainfall (mm)	100	191.7	98.3

Table 2 : Environmental indices for ten characters.

S. no.	Characters	E1	E2	E3
1	Days to 50% tasseling	-0.8816	3.3142	-2.4326
2	Number of leaves	0.0338	-1.0821	1.0483
3	Days to maturity	0.3044	2.9565	-3.2609
4	Plant height (cm)	1.6954	10.7895	-12.4847
5	Cob placement height (cm)	-1.7072	-3.7773	5.4844
6	Ear length (cm)	0.9173	-2.2716	1.3543
7	Number of kernels per row	-0.8358	0.2084	0.6275
8	Number of kernels per ear	-20.4153	-10.2227	30.6382
9	100 seed weight (g)	-1.8245	-2.2899	4.1144
10	Yield per plant (g)	-18.8632	-14.5915	33.4547

0.14, respectively. The standard spacing of 60 õ20 cm was followed throughout the sites. The soil nutrient profile was the most distinguishing factor among the three experimental sites where Nagercoil was sufficient in four micro-nutrients *viz*., Iron, manganese, zinc and copper. Tillering may have occurred due to the timely rainfall and availability of micronutrients throughput the growing stages.

Corn tillering occurs due to the availability high moisture content and soil fertility, especially during the first few weeks of the growing season (Ransom, 2014). Usually, the tiller develops much later than the main stem hence, tillers do not out compete the growth of main stem. As a result, the cob developed in the tillers is malformed or produce sparsely filled grains in the cob (fig. 2). When earless tillers are formed the photosynthates from the tillers move to the main stem and contribute to kernel setting. If both main stem and tillers bear cobs, then the movement of photosynthates is confined to the individual stem itself. So tillers can only contribute to grain yield when the main stem is damaged or the plant density is too low than the recommended one (Nielsen, 2003).

Conclusion

Appearance of tillers has no ill effect on the overall yield potential of maize hybrids and it can only be an indication of favourable growing conditions or improper plant density. Tillers could also sum to the yield potential, if the main stem is damaged. The mechanism involving in the development of tillers in modern day maize seems to be complex and further studies can be done to know the mechanism and produce productive tillers like rice.

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