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Evaluation of maize hybrids against stem borer (*Chilo partellus* Swinhoe) and cob borer (*Stenachroia elongella* Hampson) in Meghalaya of North-East India

SANDIP PATRA[1], KANCHAN SAIKIA AND N. S. AZAD THAKUR

Division of Crop Improvement
ICAR Research Complex for North-Eastern Hill Region, Umiam-793 103 (Meghalaya), India

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ABSTRACT

Studies were conducted at ICAR Research Complex for North-Eastern Hill Region, Umiam, Meghalaya during **kharif** seasons of 2009 and 2010 to evaluate some maize hybrids against stem borer (*Chilo partellus* Swinhoe) and cob borer (*Stenachroia elongella* Hampson) under field conditions. Twelve varieties viz., HIM-129, Vivek Maize Hybrid-5, Vivek Maize Hybrid-9, Vivek Maize Hybrid-15, Vivek Maize Hybrid-21, Vivek Maize Hybrid-23, Vivek Maize Hybrid-25, Vivek Maize Hybrid-33, FH-3356, Vivek QPM-9, Vivek Sankul Makka-31 and RCM-1-1 were evaluated. Results revealed that Vivek Maize Hybrid-15 recorded the lowest mean dead hearts (3.25%) followed by Vivek Maize Hybrid-5 (3.95%), HIM-129 (4.37%) and RCM 1-1 (5.72%), while highest mean dead hearts were found in FH-3356 (9.94%). On the other hand, RCM-1-1 was found least susceptible variety to cob borer (4.11%) followed by HIM-129 and Vivek Hybrid Maize-5 with 4.55 and 4.73% mean cob damage, respectively, whereas it was highest in Vivek Maize Hybrid-25 with 10.86% cob damage. Average grain yield recorded ranged from 2.87 to 5.09 t/ha in different varieties. Among the varieties evaluated, Vivek Maize Hybrid-25, FH-3356, RCM-1-1, Vivek Maize Hybrid-23, Vivek Maize Hybrid-21 and Vivek QPM-9 were found promising varieties with an average yield of 5.09, 4.71, 4.57, 4.38, 4.29 and 4.22 t/ha, respectively.

Key words : *Chilo partellus*, cob borer, hybrid maize, stem borer, *Stenachroia elongella*, varietal evaluation

INTRODUCTION

Maize is the second most important cereal crop in Meghalaya next to rice covering 16,898 ha with 24,424 tonnes production and only 1.445 t/ha productivity (Anonymous, 2009). It has been observed that maize production in India has remained almost stagnant with constant yield level despite rise in acreage due to many factors. Among these, biotic stress on maize is a major constraint to achieve the attainable yield. Maize is infested by about 139 species of insect-pests with varying degree of damage; however, only about a dozen are quite serious (Sarup *et al.*, 1987; Siddiqui and Marwaha, 1993). Of these, maize stem borer (*Chilo partellus* Swinhoe) is a key pest causing losses to grain yield, which vary between 24.3 and 36.3% in different agro-climatic regions of India. Khan *et al.* (1997) reported that the yield losses caused by stem borers to maize vary widely in different regions and ranged from 25-40% according to the pest population density and phenological stage of the crop at infestation. In Meghalaya, besides stem borer (*Chilo partellus* Swinhoe), maize is severely damaged by another dreaded pest i. e. cob borer (*Stenachroia elongella* Hampson) causing cob damage to the tune of 68.75% (Anonymous, 1997). Cob borer damage can be easily recognized by the presence of small circular entry holes on the cob. Larvae feed on grains inside the cob and make them unfit for human consumption. As cob borer infestation starts during silking stage and extends up to maturity, therefore, it is difficult to manage by frequent applications of persistent insecticides for residue problem in grain. Therefore, the main objective of this study was to screen some maize hybrids for tolerance against these pests with potential yield for this region.

[1]Department of Agricultural Entomology, BCKV, Mohanpur-741 252 (W. B.), India.

MATERIALS AND METHODS

The experiments were conducted at Entomology Farm, ICAR Research Complex for North-Eastern Hill Region, Umiam, Meghalaya, India during 2009 and 2010 with 12 varieties including 11 hybrids of maize and one traditional variety (RCM 1-1) as check to evaluate the relative resistance against stem borer and cob borer. Varieties viz., HIM-129, Vivek Maize Hybrid-5, Vivek Maize Hybrid-9, Vivek Maize Hybrid-15, Vivek Maize Hybrid-21, Vivek Maize Hybrid-23, Vivek Maize Hybrid-25, Vivek Maize Hybrid-33, FH-3356, Vivek QPM-9, Vivek Sankul Makka-31 and RCM-1-1 were sown in second week of April in randomized block design (RBD) with three replications in plot size of 3 x 2.5 m with row to row and plant to plant spacing of 55 and 25 cm, respectively. Recommended management practices except plant protection measures were followed for raising the crop. Stem borer data were recorded at 10 days intervals after infestation was noticed in the field. Observations were taken on the basis of number of infested plants and number of dead hearts from each plot and converted into per cent infestation and per cent dead hearts. Cob borer damage was recorded at harvest time by counting number of damaged cob and total number of cobs from each replication and converted into per cent cob infestation. Grain damage and number of cob borer larvae were recorded from five infested cobs wherever applicable from each replication. Yield was recorded separately for each plot. Percentage data were taken as angular transformed values for analysis only and mean data of all observations were presented in the tables. Data were analysed using Duncan's Multiple Range Test (DMRT) at 5% level of probability.

RESULTS AND DISCUSSION

Stem Borer Infestation

Stem borer infestation (plant infested and dead heart formed) data are presented in Table 1. During first and second year, plant infestation was found ranging from 13.33 to

Table 1. Stem borer infestation on different maize hybrids during 2009 and 2010

Varieties	Stem borer infestation (%)						Yield (t/ha)		
	Plant infestation			Dead heart			2009	2010	Mean
	2009	2010	Mean	2009	2010	Mean			
HIM-129	17.33^{ab} (24.60)	5.33^{a} (13.35)	11.33^{abc} (19.67)	8.06^{abc} (16.49)	0.67^{a} (4.69)	4.37^{ab} (12.07)	2.84^{abc}	3.70^{a}	3.27^{ab}
Vivek Hybrid Maize-5	13.33^{a} (21.41)	5.33^{a} (13.35)	9.33^{a} (17.78)	7.22^{ab} (15.59)	0.67^{a} (4.69)	3.95^{ab} (11.46)	1.94^{a}	3.81^{a}	2.87^{a}
Vivek Hybrid Maize-9	18.67^{ab} (25.60)	3.33^{a} (10.51)	11.00^{abc} (19.37)	10.56^{bcd} (18.96)	1.33^{a} (6.62)	5.95^{abc} (14.12)	2.76^{abc}	5.04^{ab}	3.90^{abcd}
Vivek Hybrid Maize-15	18.67^{ab} (25.60)	0.67^{a} (4.69)	9.67^{a} (18.12)	5.83^{a} (13.97)	0.67^{a} (4.69)	3.25^{a} (13.97)	2.00^{a}	5.13^{ab}	3.56^{abc}
Vivek Maize Hybrid-21	27.33^{cd} (31.52)	5.33^{a} (13.35)	16.33^{cd} (23.83)	16.94^{e} (24.30)	1.33^{a} (6.62)	9.14^{bc} (17.60)	2.62^{abc}	5.95^{ab}	4.29^{bcd}
Vivek Maize Hybrid-23	33.33^{d} (35.26)	5.33^{a} (13.35)	19.33^{d} (26.08)	16.39^{e} (23.88)	1.33^{a} (6.62)	8.86^{bc} (17.32)	2.40^{a}	6.35^{b}	4.38^{bcd}
Vivek Maize Hybrid-25	23.33^{bc} (28.88)	2.00^{a} (8.13)	12.67^{abc} (20.85)	11.39^{cd} (19.72)	0.67^{a} (4.69)	6.03^{abc} (14.21)	3.81^{c}	6.36^{b}	5.09^{d}
Vivek Maize Hybrid-33	19.33^{abc} (26.08)	2.00^{a} (8.13)	10.67^{ab} (19.06)	14.17^{de} (22.11)	1.33^{a} (6.62)	7.75^{abc} (16.16)	2.51^{ab}	5.32^{ab}	3.92^{abcd}
FH-3356	32.67^{d} (34.86)	2.67^{a} (9.40)	17.67^{cd} (24.86)	18.88^{e} (25.75)	1.00^{a} (5.74)	9.94^{c} (18.38)	3.10^{abc}	6.31^{b}	4.71^{cd}
Vivek QPM-9	24.00^{bc} (29.33)	2.00^{a} (8.13)	13.00^{abc} (21.13)	16.67^{e} (24.10)	1.33^{a} (6.62)	9.00^{bc} (17.46)	3.18^{abc}	5.25^{ab}	4.22^{bcd}
Vivek Sankul Makka-31	22.67^{bc} (28.43)	2.00^{a} (8.13)	12.34^{abc} (20.56)	14.72^{de} (22.56)	2.00^{a} (8.13)	8.36^{bc} (16.81)	3.02^{abc}	4.36^{ab}	3.69^{abc}
RCM 1-1	20.67^{abc} (27.04)	2.67^{a} (9.40)	11.67^{abc} (19.97)	9.44^{bc} (17.89)	2.00^{a} (8.13)	5.72^{abc} (13.84)	3.73^{bc}	5.40^{ab}	4.57^{bcd}

Difference in mean values was determined by DMR test. Means sharing same superscript in a column are not significantly different at 5% level of significance.

33.33% and 0.67 to 5.33%, respectively. In first year, plant infestation was found varying significantly among the varieties, whereas in second year there was no significant difference. In first year, variety, Vivek Maize Hybrid-5 showed minimum plant infestation (13.33%) which was at par with all other varieties except Vivek Sankul Makka-31 (22.67%),Vivek Maize Hybrid-25 (23.33%), Vivek QPM-9 (24.00%), Vivek Maize Hybrid-21 (27.33%), FH-3356 (32.67%) and Vivek Maize Hybrid-23 (33.33%). Lowest mean plant infestation was also found in Vivek Maize Hybrid-5 (9.33%) which was closely at par with Vivek Hybrid Maize-15 (9.67%) followed by Vivek Maize Hybrid-33 (10.67%), Vivek Hybrid Maize-9 (11.00%), HIM-129 (11.33%), RCM 1-1 (11.67%), Vivek Sankul Makka-31 (12.34%), Vivek Maize Hybrid-25 (12.67%) and Vivek QPM-9 (13.00%). Higher plant infestation was found in Vivek Maize Hybrid-21(16.33%), FH-3356 (17.67%) and Vivek Maize Hybrid-23 (19.33%).

Regarding dead hearts (DH), there was significant variation among the varieties during first year, whereas in second year, there was no statistical difference in dead heart formation. During first year, highest dead hearts were observed in FH-3356 (18.88%) which were at par with Vivek Maize Hybrid-21 (16.94%), Vivek QPM-9 (16.67%) and Vivek Maize Hybrid-23 (16.39%) and also did not differ significantly from Vivek Sankul Makka-31 (14.72%) and Vivek Maize Hybrid-33 (14.17%). Vivek Hybrid Maize-15 showed lowest dead hearts (5.83%) and these were significantly different from all other varieties except Vivek Maize Hybrid-5 (7.22%) and HIM-129 (8.06%). Further, Vivek Hybrid Maize-15 maintained its superiority with least mean dead hearts (3.25%) and significantly different from FH-3356 which recorded highest dead hearts (9.94%). Other varieties were at par with little difference in dead heart formation. Present findings are in close conformity with those of Khan and Amjad (2000) who reported 7.71 to 10.34% dead hearts on different maize varieties. These results are also partially in agreement with the results of Ahad *et. al.* (2008) who reported that mean infestation (dead heart+leaf infestation) ranged from 0 to 23.16% during **kharif** season.

Cob Borer Infestation

Cob borer infestation is presented in Table 2 for both the years. Results revealed that cob borer infestation was present on all the varieties with significant variation in both the years. Cob damage ranged from 4.13 to 9.71% and 4.09 to 14.40% for first and second year, respectively. During first year, lowest cob damage was observed in RCM 1-1, HIM-129 and Vivek Hybrid Maize-5 with 4.13, 4.37 and 4.63% damage, respectively, and these varieties did not differ statistically from Vivek Sankul Makka-31 (5.30%), Vivek Hybrid Maize-9 (6.00%),Vivek Maize Hybrid-33 (6.34%), Vivek QPM-9 (6.81%) and Vivek Maize Hybrid-21 (6.92%). Next highest cob damage was found in Vivek Maize Hybrid-23 (8.19%) followed by Vivek Maize Hybrid-15 (9.38%), Vivek Maize Hybrid-25 (9.54%) and FH-3356 (9.71%). In second year, some varieties maintained similar trend with minimum cob damage in RCM 1-1 (4.09%), HIM-129 (4.46%), Vivek Sankul Makka-31 (5.03%), Vivek Hybrid Maize-5 (5.09%), FH-3356 (5.14%), Vivek Hybrid Maize-15 (5.32%), Vivek Hybrid Maize-21 (5.84%) and Vivek Maize Hybrid-9 (6.71%) which were at par with each other. Highest cob infestation was noticed in Vivek QPM-9 (14.40%) followed by Vivek Maize Hybrid-25 (12.18%), Vivek Maize Hybrid-23 (10.78%) and Vivek Maize Hybrid-33(10.71%). Least mean cob borer damage was observed in RCM 1-1 with 4.11% followed by HIM-129, Vivek Hybrid Maize-5 and Vivek Sankul Makka-31 with 4.55, 4.73, and 5.17% cob damage, respectively, whereas highest was in Vivek Maize Hybrid-25 (10.86%) which did not differ significantly from Vivek QPM-9 (10.61%), Vivek Maize Hybrid-23 (9.49%) and Vivek Maize Hybrid-33 (8.53%). Azad Thakur (1993) reported 80.0, 66.67, 54.76 and 15.07% cob borer infestation in 1988, 1989, 1990 and 1991, respectively, which indicated the severity of this pest in this region. These results were supported by Shylesha (1996) who reported 5-39% cob borer damage on seven maize varieties in this region.

Grain Damage

The data pertaining to grain damage

Table 2. Cob borer infestation on different maize hybrids during 2009 and 2010

Varieties	Cob borer infestation (%)						No. of larvae/cob		
	Cob damage			Grain damage			2009	2010	Mean
	2009	2010	Mean	2009	2010	Mean			
HIM-129	4.63^{a} (12.42)	4.46^{a} (12.19)	4.55^{ab} (12.32)	11.93^{ab} (20.21)	8.92^{de} (17.38)	10.43^{ab} (18.84)	1.53^{a}	1.27^{a}	1.40^{a}
Vivek Hybrid Maize-5	4.37^{a} (12.07)	5.09^{a} (13.04)	4.73^{ab} (12.56)	10.56^{ab} (18.96)	6.50^{bcd} (14.77)	8.53^{ab} (16.98)	1.33^{a}	0.87^{a}	1.10^{a}
Vivek Hybrid Maize-9	6.00^{abc} (14.18)	6.71^{ab} (15.01)	6.36^{bcd} (14.61)	10.31^{ab} (18.73)	4.61^{abc} (12.40)	7.46^{ab} (15.85)	1.27^{a}	1.00^{a}	1.13^{a}
Vivek Hybrid Maize-15	9.38^{cd} (17.83)	5.32^{a} (13.33)	7.35^{cde} (15.73)	20.47^{b} (26.90)	3.40^{ab} (10.62)	11.94^{ab} (20.21)	1.33^{a}	0.80^{a}	1.07^{a}
Vivek Maize Hybrid-21	6.92^{abc} (15.25)	5.84^{a} (13.98)	6.38^{bcd} (14.63)	16.83^{ab} (24.22)	4.75^{abc} (12.59)	10.79^{ab} (19.18)	1.07^{a}	0.67^{a}	0.87^{a}
Vivek Maize Hybrid-23	8.19^{bcd} (16.63)	10.78^{bc} (19.17)	9.49^{ef} (17.92)	5.48^{a} (13.54)	7.99^{cde} (16.42)	6.74^{a} (15.05)	0.87^{a}	0.93^{a}	0.90^{a}
Vivek Maize Hybrid-25	9.54^{d} (17.99)	12.18^{c} (20.43)	10.86^{f} (19.24)	20.15^{b} (26.67)	2.85^{a} (9.72)	11.50^{ab} (19.82)	1.80^{a}	0.47^{a}	1.13^{a}
Vivek Maize Hybrid-33	6.34^{abc} (14.58)	10.71^{bc} (19.10)	8.53^{def} (16.98)	11.66^{ab} (19.97)	5.03^{abc} (12.96)	8.35^{ab} (16.79)	1.13^{a}	0.87^{a}	1.00^{a}
FH-3356	9.71^{d} (18.16)	5.14^{a} (13.10)	7.43^{cde} (15.82)	16.74^{ab} (24.15)	4.11^{ab} (11.70)	10.43^{ab} (18.84)	1.13^{a}	0.80^{a}	0.97^{a}
Vivek QPM-9	6.81^{abc} (15.13)	14.40^{c} (22.30)	10.61^{f} (19.01)	16.92^{ab} (24.29)	11.48^{e} (19.80)	14.20^{b} (22.14)	1.47^{a}	1.33^{a}	1.40^{a}
Vivek Sankul Makka-31	5.30^{ab} (13.31)	5.03^{a} (12.96)	5.17^{abc} (13.14)	17.12^{ab} (24.44)	3.97^{ab} (11.49)	10.55^{ab} (18.95)	1.20^{a}	0.53^{a}	0.87^{a}
RCM 1-1	4.13^{a} (11.72)	4.09^{a} (11.67)	4.11^{a} (11.70)	10.94^{ab} (19.31)	6.33^{bcd} (14.57)	8.64^{ab} (17.09)	1.47^{a}	0.80^{a}	1.13^{a}

Difference in mean values was determined by DMR test. Means sharing same superscript in a column are not significantly different at 5% level of significance.

are shown in Table 2, which reveal that grain damage of infested cob ranged from 5.48 to 20.47% and 2.85 to 11.48% during first and second years, respectively. During first year, lowest grain damage was found in Vivek Maize Hybrid-23 (5.48%) which was at par with other varieties except Vivek Maize Hybrid-15 (20.47%) and Vivek Maize Hybrid-25 (20.15%), whereas all other varieties were at par with each other with minimum variation in damage. In second year, least percentage of grain damage was observed in Vivek Maize Hybrid-25 (2.85%) which was at par with Vivek Hybrid Maize-15 (3.40%), Vivek Sankul Makka-31 (3.97%), FH-3356 (4.11%), Vivek Maize Hybrid-9 (4.61%), Vivek Maize Hybrid-21 (4.75%) and Vivek Maize hybrid-33 (5.03%) which was significantly different from HIM-129 (8.92%) and Vivek QPM-9 (11.48%). Mean lowest grain damage was found in Vivek Maize Hybrid-23 (6.74%) which was at par with other varieties with least variation in infestation except Vivek QPM-9 which showed highest percentage of grain damage (14.40%). Literature is scanty regarding grain damage within infested cob but number of larvae per cob as reported by Azad Thakur (1990) ranged from 3 to 5 larvae/cob which partially supported the present investigation. Further, Shylesha (1996) observed that the number of cob borer larvae ranged from 2 to 15/cob.

Yield

From Table 1, it is clear that yield varied significantly among the different varieties in both the years. During first and second year, yield recorded varied from 1.94 to 3.81 and 3.70 to 6.36 t/ha, respectively. Highest yield was recorded in Vivek Maize Hybrid-25 with 3.81 and 6.36 t/ha, respectively, in both the years. During first year, Vivek Maize Hybrid-5 recorded lowest yield (1.94 t/ha) which was at par with Vivek Maize Hybrid-15 (2.00 t/ha) and Vivek Maize Hybrid-23 (2.40 t/ha). It was also not found significantly different from other varieties except RCM 1-1 (3.73 t/ha) and Vivek Maize Hybrid-25 (3.81 t/ha). In second year, lowest yield was recorded in HIM-129 (3.70 t/ha) and Vivek Maize

Hybrid-5 (3.81 t/ha) which was at par with other varieties but statistically different from Vivek Maize Hybrid-23 (6.39 t/ha), FH-3356 (6.61 t/ha) and Vivek Maize Hybrid-25 (6.36 t/ha). Highest average yield was also recorded in Vivek Maize Hybrid-25 with 5.09 t/ha which significantly differred from other varieties except FH-3356 (4.71 t/ha), RCM 1-1 (4.57 t/ha), Vivek Maize Hybrid-23 (4.38 t/ha), Vivek Maize Hybrid-21 (4.29 t/ha) and Vivek QPM-9 (4.22 t/ha), while lowest average yield was found in Vivek Maize Hybrid-5 (2.87 t/ha) followed by HIM-129 (3.27 t/ha). Most of the results were similar with the results of Kaul *et al.* (2010) who reported average yield of maize hybrids ranging from 40-60 q/ha but yield of some varieties was not in agreement with their results like HIM-129 and Vivek Maize Hybrid-5 which yielded lower than their findings, it may be due to variable geographical adaptation of varieties.

CONCLUSION

However, some results of present investigation are not much similar with the results reported by several authors earlier; these may be due to different adaptable capacity of maize hybrids in new area as well as variable biotic stresses in particular agro-climatic condition. Performance of all varieties was good during second year as compared to first year results, it may be due to very less biotic stress during second year. Trend of some results such as dead heart formation and yield for two years gave clear indication of superiority of some potent varieties for this region. Among tested hybrids, HIM-129, Vivek Hybrid Maize-5 and Vivek Hybrid Maize-15 were least susceptible to stem borer, whereas HIM-129, Vivek Hybrid Maize-5 and RCM 1-1 were minimum susceptible to cob borer with moderate yield. Vivek Maize Hybrid-25, FH-3356, Vivek Maize Hybrid-23, Vivek Maize Hybrid-21 and Vivek QPM-9 were high yielder with relatively more damage by pests. Considering all findings from this study, it may be concluded that the high yielder varieties may be recommended to the farmers along with traditional variety RCM 1-1 for this region.

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