

## Effect of Planting Dates and Varieties on Infestation of Maize Stem Borer *Chilo partellus* (Swinhoe)

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### Abstract

Studies on the effect of different planting dates and varieties of maize on the infestation of maize stem borer (*Chilo partellus*) were carried out at research field of National Maize Research Program, Rampur, Chitwan, Nepal in 2010/11 and 2011/12. Three maize varieties namely Arun-2, Rampur Composite and Gaurav (hybrid) were grown at weekly interval upto 52 weeks from January to December. The results revealed that the damage was higher in Arun-2 (38.9%) followed by Gaurav (35.4%) and Rampur Composite (30.8%) respectively. Higher damage was observed in April (58.2%) and the damage was gradually decreased toward the month of January/February (13.2 to 25.6%) and November /December (13.3 to 16.5%). Lower infestation was observed in winter season (22.5%) followed by spring (47.1%) and summer season (47.0%) respectively. This study suggests that the percent infestation of maize stem borer can be minimized by planting Rampur Composite variety in winter season.

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### Introduction

The yield of maize crop is adversely affected due to insect pests, diseases, weeds, nematodes and birds etc. The major insect pests that attack maize crop include maize aphids, cutworms, stem/shoot fly, root worm and stem borer. The grain losses range from 10-15% due to insect pests alone (Jaipal and Dass, 1993). Maize stem borer *Chilo partellus* Swinhoe is the most serious pest (Kumar *et al.*, 1993). The damage due to insect pest complex depends upon their population trends in the field which, in turn, rely upon their dynamically of the physical factors of their immediate environment (Isard, 2004). Pests of maize are strongly influenced by weather conditions and are very difficult to predict. A thorough understanding of the exact relationship between the change in environmental factors and those in the pest population may not only help anticipate the pest losses to the crop, but also help avoid them

through some well-timed pest control measure. Insect damage decreases the yield and lower grain quality (Rahman *et al.*, 1994). Low productivity (2.5 ton/ha) of maize in Nepal is attributed to many reasons. Among them is the attack of various insect pests. The cumulative effect of pests including some other minor insects on maize yield is reported to be 33-41% at Khumaltar (Joshi, 1977). Among the serious pests, Maize stem borer, *Chilo partellus* Swinehoe (Lepidoptera: Pyralidae) is one of the major biotic constraints in successful maize production throughout the country and abroad (Pingali 2001, Dhaliwal and Arora 2001, Sekhon and Kanta 1997). The larvae (caterpillars) eat through leaves when young and as they grow older, eventually bore into the stem causing it to break or die.

Various approaches have been made to control maize stem borer including cultural, physical, biological and chemical in an uncoordinated manner throughout the country. Not much attempts have been made to look into the level of infestation in the stubble and particularly in the stalks. The use of pesticides in crop protection has certainly contributed for minimizing yield losses however quite often the indiscriminate and unscientific use of pesticides has led to the many problems.

Keeping in view the importance of maize crop and the severity of damage caused by maize stem borer the present experiment was conducted with the following objectives.

1. To find out a proper sowing date for the maize crop in Chitwan, Nepal.
2. To find out the link between the sowing date and infestation so as to avoid damage from maize stem borer.

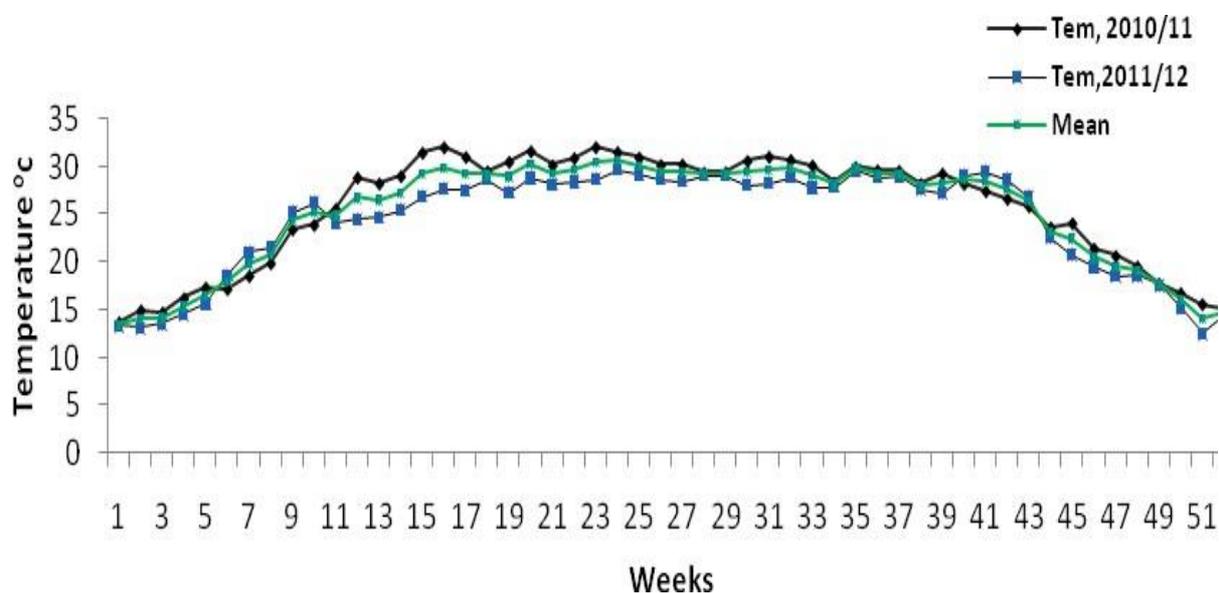
## Materials and Methods

A field experiment composed of three popular and released maize varieties namely Arun-2 (Short duration), Rampur Composite (Full season) and Gaurav (Hybrid) were seeded round the year in weekly interval at National Maize Research Program (NMRP), Rampur, Chitwan, Nepal during two consecutive years of 2010/11 and 2011/12. The experiments were laid out in a randomized complete block design with three replications. Individual plot size was 2 rows of 5m length and spacing was 75 × 20 cm between row to row and plant to plant. The field was fertilized with chemical fertilizer @ 120:60:40 kg NPK/ha. Half dose of Nitrogen with full dose of Phosphorous and Potash was applied at the time of planting and the remaining nitrogen was top dressed at the time of second weeding. All intercultural operation was provided as per recommendation of NMRP for good plant stand. The plots were surveyed at weekly interval for the presence of pests. Individual plants in each variety were thoroughly examined and damage done by stem borer. Insects damage rating as visual score (0-9 scale), total healthy and damage plants/plots, tunnel length (cm) inside the stalk, exit holes, pin holes, tattering stage and dead heart record were done as ascribed by Ampofo and Saxena (1987), CIMMYT, Mexico. The data pertaining to dead heart and infestation was pooled together. General rating was done in 1-9 scale where 1 indicated resistant and 9 as a highly susceptible to the pests. Ten randomly selected stalks from two rows of each genotype were taken for tunnel length measurement during harvesting time. Each stalk was longitudinally cut by the help of knife and recorded length of tunnel in centimeter scales and numbers of exit holes formed by adult borer inside the stalk.

Similarly the data on temperature obtained from the meteorological observatory of NMRP, Rampur, Chitwan, Nepal. Available observations were collected, summarized in weekly and monthly basis and presented in tabular and graphic forms.

## Results and discussion

The result of the present study inferred that insects injury was approximately in the same trend in both the years proportional to prevailing temperature. Percentage stem borer infestation was gradually increased toward the progress of weeks and more or less remained constant from 10 to 42 weeks and further start declined gradually. The trend of temperature as was also alike to that of insect infestation. Thus the temperature was pronounced resulting in higher percentage of infestation (Figure 1). Thus, it is cleared that the above mentioned temperature is most congenial for pests' growth and development. These finding was confirmed with the work of Tamiru *et al.* (2012) as most suitable condition for *Chilo partellus* Swinehoe development was 26 to 30 °C temperature. Regarding the maize growing season, mean of the weeks revealed that borer damage was comparatively less (22.5%) at 21.1°C during winter seeded maize plants than spring (47.08% at 28.78°C) and rainy (47.03% at 29.2°C). The above statement is supported by Muhammad *et al.* (2010) that the infestation of *Chilo partellus* Swinehoe was found highest at higher temperature (32.5°C).



### 2010/11

Minimum temperature: 13.7°C on January 1<sup>st</sup> week  
 Maximum temperature: 32.05°C on June 1<sup>st</sup> week  
 Average of the year: 25.6°C

### 2011/12

Minimum temperature: 12.5°C on December 3<sup>rd</sup> week  
 Maximum temperature: 29.98°C on June 2<sup>nd</sup> week  
 Average of the year: 24.35°C

**Figure 1. Effect of temperature fluctuation on insects' population growth and its result on maize genotypes during two consecutive years of 2010/11 and 2011/12 at NMRP, Rampur, Chitwan, Nepal**

As shown in Table 1, among the varieties tested, mean result of the weeks inferred that Arun-2 (Short duration) was slightly more sensitive to maize stem borer damage (38.9%) than Gaurav (35.4%) and Rampur Composite (30.8%). The range of damage varied from 8.7-65.2% in Arun-2, 3.4- 58.6% in Rampur Composite and 9.6-72.2% in Gaurav. Maximum infestation of 72.2% was observed in Gaurav variety on 16 weeks at which 29.8°C temperature was recorded followed by 65.2% damage in Arun-2 on 15 weeks at 29.2°C and 58.6% damage in Rampur Composite on 16 weeks at 29.8°C. Thus from the above depicted

figure, it could be clarified that around 29 °C temperature fall on 15-16 weeks (April) was most congenial for the growth and development of borer. Rampur Composite was found more resistant variety. Large number of maize genotypes with resistance to *Chilo partellus* has been reported (Kumar, 1993).

**Table 1. Response of maize varieties/hybrid to maize stem borer damage (%) in weekly interval seeded experiment at NMRP, Rampur, Chitwan, Nepal (Average data of two years of 2010/11 and 2011/12)**

Weeks	Arun-2	Rampur Composite	Gaurav	Weeks	Arun-2	Rampur Composite	Gaurav
1	9.2	8.3	9.6	27	50	33.3	38
2	11.4	9.5	11.1	28	44.4	38.9	38.6
3	14.3	15.4	20	29	62.5	36.7	43.8
4	22.7	12	28	30	57.7	40	37.3
5	28	19.2	24	31	48.7	36.8	42.8
6	33.5	24.8	20	32	52.2	33.3	52.7
7	42.8	25	27.3	33	33.3	33.3	36.7
8	38.6	27.5	30.8	34	39.2	37.3	20
9	43.6	35	56.5	35	54.5	35	43.7
10	54.5	36	58	36	47.5	39.7	60
11	57.1	35.4	40	37	36.4	37.6	36.7
12	44	33.8	41.7	38	30	35	33.3
13	38.9	40.9	48	39	34.1	34.7	33.3
14	52.2	36.4	36	40	35.4	32.3	37.5
15	65.2	52.8	64.7	41	34.8	33.3	40
16	56.5	58.6	75.2	42	37.7	35.7	25
17	48	52	63.6	43	35	20.8	25
18	60.6	55.4	57.7	44	30	12.5	30
19	63	37.7	38.6	45	30	25	28.2
20	52.4	36.7	43.7	46	24	16.7	16.7
21	54.5	42.1	40	47	16	13.3	18.3
22	50	48.3	37.5	48	15.8	6.7	12.7
23	53.3	44.5	50	49	16.7	12.7	20
24	42.8	41.7	38.6	50	18.6	6.7	11.1
25	37.7	37.5	40	51	20.8	3.4	14.8
26	32	34.4	33.3	52	8.7	9.1	11.2
Mean of 52 weeks					38.9	30.8	35.4

Likewise, mean of all parameters mentioned in Table 2 indicated that insect rating (3.66 to 3.99 score), percent insect damage (34.3 to 33.9%), tunnel length (11.59 to 16.34 cm) and exit holes number (2.64 to 3.8) were approximately similar in both the tested years. However, average range of score was varied from 1.96 to 6.1, percent infestation (13.2 to 58.2%), tunnel length (4.45 to 22.8 cm) and exit holes number (1.9 to 6.0). Moreover, average

infestation of borer was highest in the month of April (58.2%) followed by May (48.2%) and July (44.9%). The approximately same trend of damage was found in other parameters (score, tunnel length and exit holes) too. During January/February (13.2 to 25.6%) and November/December (16.5 to 13.3%), infestation was low whereas fluctuating infestation was recorded from March to October (29.0 to 58.2%).

The environmental conditions in NMRP, Rampur, Chitwan, Nepal is normally favorable for buildup of insect populations large enough to cause serious damage to maize. The highest percentage of damage by stem borer was occurred during rainy or summer season and that was lowest in winter season. The percentage of damage depends on the extent of insect population. During the summer (rainy) season the population of stem borer increased so the damage extent was increased. This result can be deduced from the foregoing results of the locations that temperature plays a significant effect for growth and development of maize stem borer damage which is supported by Tamiru *et al.* (2012). According to him, the physical factors like atmospheric temperature are known to play an important role in the life cycle of insects and adaptability to local climate. Mbapila *et al.* (2002) also targeted temperature as a primary factor for mortality, growth and development lepidopterans.

**Table 2. Monthly fluctuation of Maize stems borer infestation during two consecutive years of 2010/11 and 2011/12 at NMRP, Rampur, Chitwan, Nepal**

Month	Score (0-9 scale) Mean		% Damage		Mean	Tunnel length (cm)		Mean	Exit holes (number)		Mean	
	2010/11	2011/12	2010/11	2011/12		2010/11	2011/12		2010/11	2011/12		
	January	1.33	2.6	1.96	11	15.4	13.2	4.8	9.5	7.15	1.7	2.6
February	2.3	3.4	2.85	19.9	31.2	25.6	9.5	12.1	10.8	1.6	2.4	2
March	5.1	4.9	5	43.1	42.2	42.7	10.1	18.3	14.2	1.6	2.5	2.1
April	6.1	6.2	6.1	64.8	51.6	58.2	20	18.8	19.4	2.6	2.7	2.6
May	5.5	5.6	5.5	46.9	49.5	48.2	17.2	20.9	19.1	3.4	2.2	2.8
June	5.2	3.3	4.25	46	31.1	38.6	13.1	18.1	15.6	4.4	2.7	3.5
July	4.3	5.2	4.75	39	50.7	44.9	11.5	14.8	13.2	5.1	6.8	6
August	3.7	4.6	4.15	36.9	43	40	18.9	26.7	22.8	3.6	7.9	5.7
September	4.2	4.1	4.15	42.2	37.8	40	13.5	27.3	20.4	3.2	7.3	5.2
October	3.3	2.6	2.95	37	21	29	11.2	18.1	14.7	1.2	3.9	2.5
November	1.6	2.6	2.1	16.2	16.8	16.5	5.4	6.5	5.95	1.5	2.6	2.1
December	1.3	2.8	2.05	9	17.6	13.3	3.9	5	4.45	1.7	2.1	1.9
<b>Mean</b>	3.66	3.99	3.82	34.33	33.9	34.2	11.59	16.34	14	2.64	3.8	3.2

**Table 3. Response of maize stem borer damage based on maize growing seasons during two consecutive years of 2010/11 and 2011/12 at NMRP, Rampur, Chitwan, Nepal**

S.N.	Winter season /weeks	% Borer damage	Temperature (°C)	Spring season /weeks	% Borer damage	Temperature (°C)	Rainy season /weeks	% Borer damage	Temperature (°C)
	August			March			April		
1	35	42.0	29.78	10	47.02	25.10	14	45.35	26.48
2	36	39.5	29.28	11	42.10	24.86	15	54.93	27.23
3	37	45.2	29.28	12	41.50	26.69	16	62.22	29.18
4	38	39.2	27.92	13	46.77	26.48	17	56.32	29.84
5	39	39.3	28.24	14	45.35	27.23	18	58.12	29.28
6	40	33.5	29.10	15	54.93	29.18	19	53.42	29.11
7	41	34.7	28.49	16	62.22	29.84	20	47.28	28.90

8	42	28.8	27.64	17	56.32	29.28	21	47.55	30.22
9	43	27.7	26.33	18	58.12	29.11	22	49.12	29.14
10	44	22.7	23.14	19	53.42	28.90	23	43.85	29.63
11	45	17.8	22.43	20	47.28	30.22	24	47.23	30.46
12	46	17.9	20.45	21	47.55	29.14	25	41.00	30.60
13	47	14.4	19.60	22	49.12	29.63	26	41.30	30.08
14	48	12.9	19.07	23	43.85	30.46	27	40.33	29.44
15	49	12.3	17.70	24	47.23	30.60	28	42.15	29.35
16	50	11.2	16.01	25	41.00	30.08	29	41.52	29.21
17	51	5.5	14.09	26	41.30	29.44	30	41.92	29.24
18	52	4.5	14.77	27	40.33	29.35	31	44.77	29.37
19	1	8.2	13.49	28	42.15	29.21	32	48.77	29.69
20	2	8.0	14.05	29	41.52	29.24	33	41.88	29.79
							August		
21	3	13.4	14.16	30	41.92	29.37	34	38.65	28.94
				August					
22	4	16.6	15.40	31	44.77	29.69			
23	5	20.2	16.51						
24	6	18.7	17.93						
25	7	26.1	19.82						
26	February 8	25.6	20.73						
	<b>Mean</b>	22.5	21.16		47.08	28.78		47.03	29.2

## Conclusions

The finding of the present experiment showed that Rampur Composite, a popular and widely adopted maize variety was found more tolerate against maize stem borer infestation as compared to other varieties. Moreover, maize stem borer was identified as a key pest infested more in spring and summer season than winter season. Vegetative stages (below knee high) are more vulnerable than older stage of crop. The role of temperature at the range of 25-30°C played a significant effect for insects growth and development.

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