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Seasonal occurrence of pulse pod borer *Helicoverpa armigera* (L.) on chick pea at central U.P. region

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Abstract
Gram pod borer, Helicoverpa armigera is the most damaging pest where pulse crop is grown. The incidence of the pod borer, Helicoverpa armigera Hubner in chick pea commenced from second week of December and sowing dates with its initial intensity of 2-0.4 larva/m row length which increased subsquently upto second week of January. The larval populations increased average temperature and relative humidity varied between 19.1 to 26.91 ^{0}c at 51.42 to 65.85 percent during March respectively which suported the pest multipication in reaching well above the threshols level highily significant correlation (r=0.7012to –o.7737). Rainfall and wind velocity exhibited insignificant negative (r=0.1570 to 0.4342) impect of the pest population. However the evoparation rate could paly significant role postive role (r=0.5405 to 0.7007) on the pest intesity when the crop sown 3rd week November. Thus, the average temperature, relative humidity, evaporation rate and sunshine hours ranging between 19.1 to 29.91^{0}c, 51.42 to 65.85^{0}c percent 0.972 to 1.8 mm/ day and 6.92 to 9.14 hours / day were found conducive for the pest multiplication of gram pod borer, respectively. These results are in accordance with those of Dahiya *et al*. (1997), who reported that temperature between 19 to 28^{0}c and relative humidity 51 to 58 percent, were conducive for multiplication of gram pod borer (H. armigera) in chickpea.

Keywords: *H. armigera*, Chick pea, Pod borer, Pulses, Seasonal incidence

Introduction
Chickpea (*Cicer arietinum* L) commonly known as gram, Bengal gram, and garbanzo bean is only of the most important Rabi crop grown India. The grains consist about 52-70 percent carbohydrate, 8-22 percent protein and 4-10 percent fat. The daily per capita availability of 14 gm chickpea is source of approximately 2.3 percent 956 k (CAL) energy, 4-7 percent (2.5g) protein to Indian population, besides being a major source of calcium and iron (Ali *et al*., 2003) [1]. Chickpea is raised over an area of 11.5 million tone in the world with a production of 8.58 million tone and productivity around 769.4 kg/ ha. 2004 (FAO). India occupies first position in the world in term of area (64%) during 2003-04. The crop occupies 5.12 million hectare area with production of 5.79 million tones and 813 kg/ ha productivity (Kumar *et al*., 2005) [5]. Chickpea faces the attack of more than 60 insects–pests right from germination to maturity (Srivastava. 2005) [13]. Among them, gram pod borer, *Helicoverpa armigera* Hubner is considers as key pest causing 29% yield losses in chickpea at national level. *Helicoverpa armigera* is a charismatic and one of the most dominant insect pests in agriculture, accounting for half of the total insecticides used in India for protection of crops. The problem of this pest is magnified due to its direct attack on fruiting structures, voracious feeding habits, high mobility and fecundity, multivoltine nature, overlapping generations, nocturnal behavior *etc*., (Sarode, 1999) [15]. At the same time adequate ecological data is prerequisite for integrated pest management, which can therefore be enhanced after determining the seasonal abundance (Mathur *et al*. 2003) [9]. The knowledge on the seasonal incidence of pulse pod borer will certainly be helpful in formulating the insect pest management strategies for *Helicoverpa armigera* at Kanpur condition.

Material Method
The investigation on seasonal occurrence of gram pod borer on chickpea verities (Avarodhi, Udai (KPG-59) and Pragati) sown on different dates, were conducted at student Instruction Farm, Crop research Farm, Nawabganj, Old dairy Farm and oil Farm and Oiled seed Research farm, Kalayanpur and laboratory of Department of Entomology C.S.A. University of Agriculture and Technology Kanpur (U.P.) during rabi. Chick pea was raised by all the recommended agronomical practices except plant protection measures which enabled the

buildup of insect pests in a pesticide free environment. The fields of each variety sown at different dates were divided into ten equal pars and the total population of gram pod borer was counted in 1 meter row length selected randomly from each part of the field at weekly intervals from the appearance of the pest as suggested by Saini and Jaglan (1998) [19] and Ahamed and Rai (2005). Mean intensity of the larvae was calculated by averaging the population noticed in all the ten parts of the field. Larval intensity of gram pod borer was recorded till the availability of the pest in the field or till maturity of the crop. The data on maximum and minimum temperature, relative humidity, sunshine hours, and rainfall and wind velocity prevailing during the crop season was collected from department of Agronomy of University, which were converted as according to the standard weeks. The data were correlated with the population of pod borer.

Result and Discussion

The pest appeared in the second week of December i,e., 50th standard week on all almost all the verities irrespective of sowing dates. Initially the incidence of gram pod borer noticed to be 0.2, 0.4, 0.2, 0.2 and 0.3 larvae/m row length on Udai (KPG-59) sown in 3rd, 4rd week of November, variety Avarodhi sowing during 3rd week of October and November and Pragati sown in 3rd week of November, respectively. The pest appeared on 15-20 days old crop sown during second fortnight of November, while chickpea variety Avarodhi was about 40 days old.(3rd week of October sown crop). As the pest appears in seedling stage, it is feeds voraciously on the primordial leaves and tender twigs of the young plant which resulted in the enhancement of pest population. Chickpea variety Udai (KPG-59) sown during 3rd and 4th week of November received 0.2-2.9 and 0.4-6.6 larvae/ m row with an average intensity of 1.03 and 1.59 larvae/m row length, respectively. This variety sown in the 3rd week of November (D/S 19.112007) could touch the intensity of 1 larvae/ m row in the last week of December, which decreased thereafter and the intensity below one larvae/m row length continued till mid February (8th Standard week). The pest population increased gradually from the mid February being the crop in flowering and podding stage, which torched to the maximum intensity of 2.9 larvae/m row length in the end of March (13th stared week) and decreased abruptly thereafter during April sowing 1.1 larvae/ m row length. But the intensity on the same verity Udai sown in 4th week of November was little bit different, as the intensity crossed the economic threshold level (ETL) of one larvae/m row length during 51st to 1st standard week (i.e. second fortnight of December to 1st week of January). Interestingly, the larval intensity in late sown crop (4th week of November) attained the stares of pest in reproductive phase of the crop due to crossing its intensity above the ET level of 1 larvae/m row length in mid February (i,e., 8th Standard week), which increased up to the end of March being 6.6 larvae / m row length and showed reduction towards the maturity of crop in April. Chickpea variety Avarodhi sown at two different sowing dates i,e., 3rd week of October (normal sown) and November (late sown) had infestation of gram pod borer during 2nd week of December (50th std. week) with initial intensity of 0.2 larvae/ m row length on both the sowing dates, which increased thereafter. On October sown crop, the pest intensity torched ET level of 1 larvae / m row length in 52nd Standard weeks and cross it in 11th Standard weeks (1.4 larvae/m row). Except these two weeks, the pest intensity remained below economic threshold level during the crop season resulting in low general equilibrium position of 0.56 larvae/m row length. Late sown crop on November 17th (2007) (3rd week of November) harbored the intercity of this pest above ETL being 1.1 to 1.5 larvae/m row length during 51st to 1st Standard week in the vegetative phase of the chickpea crop. However, from 2nd week of January to mid February was proved to be incondusive period for the gram pod borer infestation as having only less than 1 larvae/m row length. It increased thereafter from 8th std. week (mid February) sowing maximum intensity of 3 larvae/m row length in 13th std. week (end of March). This period with the reproductive phase of the crop, which is the most vulnerable crop stage for its infestation in chickpea. General equilibrium position of the pest was 1.17 larvae/m row lengths, which was slightly above the ETL of the pest showing same degree of tolerance or resistance in this verity in comparison to others. The incidence of gram pod borer on chickpea variety Pargati sown in 3rd week of November (D/S 17.11.2007) was also was started in the middle of December ranging from 0.3 to 3.6 larvae/m row length. However, in the crucial period of vegetative phase, the crop was showing>-1 larvae/m row length from mid December to 1st week of January. The pest remained below the threshold level between 2nd week of January to 2nd week February and increased thereafter. The crop attained podding stage in February, which invited the pest showing higher incidence. The intensity being 1-3.6 larvae/m row length was recorded in increasing trend during February-March (7-13th Standard weeks), which decreased thereafter at the maturity of the crop. The general equilibrium position of gram pod borer was calculated to be 1.31 larvae/m row lengths on this variety.

Conclusively it can be inferred from the aforesaid results on the population dynamics of gram pod borer on chick pea varieties sown at different dates that the pest appeared in the 1st fortnight of December irrespective of variety and sowing dates. The intensity of this pest peaked during 51st to 1st standard weeks in vegetative phase 3 of the crop and again from 8th to 13th standard weeks (mid February to end of March) in reproductive stage on all the varieties sown of different dates. This trend of pest intensity exhibited that gram pod borer received tow peaks of infestation. First week occurred in December, while the second peak during the end of February to March. The intensity of gram pod borer in its first peak during vegetative phase of crop superseded the economic threshold level of the pest only for 2-3 weeks in late sown chickpea crop, while 1-2 weeks in timely sown crop (3rd week of October). The intensity above ETL of this pest during vegetative phase i.e., 1.0-1.5 larvae/m row length irrespective of variety for the shorter span during this phase we may help to the crop by nipping the primordial position of the plants by its larvae. As nipping in chickpea is required at early stage of vegetative phase of crop for good vigor of plants and better production, a slightly higher intensity during early vegetative phase of the crop can be tolerated to serve the aforesaid purpose in late sown situations of the chickpea crop. It is well clear from the intensity of gram pod borer noticed on chickpea variety Avarodhi sown at recommended time during 3rd week of October that the larval intensity could touch the ETL once in vegetative phase and once in reproductive stage of crop. In case of late sown condition, the appearance of the pest was noticed in the same period with i,e., second fortnight of December with slightly higher intensity for 2-3 weeks in vegetative phase, but the intensity was much higher during reproductive phase of the crop sown during 4 weeks of November (1.06-6.6 larvae/m row length) in comparison to

the intensity (1.1 to 2.9 larvae/m row length) noticed on the early sown in 3rd week of November.

Two peaks, of gram pod borer incidence in chickpea during December- January and February-March received in present studies get full support from the views of Yadav *et al* (1993) [21], who also reported two peaks of gram pod borer in December-January and March-April on chickpea crop. The appearance of pest during mid-December irrespective of sowing dates is in accordance with Ravi and Verma (1997) [12], who reported the incidence of gram pod borer on chickpea in first week January and reached its peak in March irrespective of date of sowing. Slightly higher incidence of gram pod borer during December to early January was noticed in all varieties irrespective of sowing date which declined during the winter season *i,e*., January-February but crossed the ET level in March. This result corroborates with that of Khurana (1997) [8]. Who reported higher population of gram pod borer during Nonmember-December but, declined in the winter season (January-Febuarvary) and the population crossed the ET level in the first week of March. Lower intensity of this pest in vegetative phase of chickpea was recorded in comparison to higher population of pest during reproductive phase received the support of Singh *et al*. (2005) [14] who also reported similar result from Rajasthan. Lower incidence of this pest in early sowing of the crop in compression to the higher intensity noticed on late sown crop are in accordance with those of Taleker *et al*. (1991) [20] Begum *et al*. (1992) [3] Garg and Verma (1995) Prasad and Singh (1997) [11] and Patnaik (2004) [10] who reported the similar finding on the effect of sowing dates in chickpea.

Relationship between intensity of gram pod borer and weather parameters

The appearance of gram pod borer was noticed in 2nd week of December irrespective of variety sowing dates with its initial intensity of 0.2-0.4 larvae/m row length, which increased subsequently up to 1st week of January. During this period, the pest intercity increased and crossed the economic threshold level (1 larvae/ m row length) of this pest in the seedling stage of the crop. Shan and Shazad (2005) [16], observed that the infestation of gram pod borer on chickpea started from 3rd week of October and first week of November up to the middle of March. He recorded the highest population in second week of December and 2nd peak in first and third week of January. Suganthy and Chaurasia (2003) [18] also reported that there were three peaks in the larval population and the peak activity of the pest was observed in the first fortnight of December, January and February when the crop was at peak podding stage. This sizable enhancement in the population of gram pod borer appeared to be influenced by the weather factors particularly the temperature and relative humidity. During the seedling stage, maximum and minimum temperature ranged between 22.34-16.04 ^{0} c and 6.52-9.75^{0}c, respectively, with an average temperature of 15.16 to 16.04^{0}c, while maximum and minimum relative humidity varied between 80.85 to 88.14 percent and 39.14 to 56 percent with the average of 60.42 to 72.07 percent, respectively. The pest intercity on all the varieties sown of different dates remained between 0.5 to 1.0 larvae/m row length from 2nd week of January to end of February (2nd to 8th standard week) due to decrease in temperature (average temperature 12.o1 to 16.41^{0}c) and relative humidity (average relative humidity 49 to 68.84 percent). The crop received flowering podding in February with rise in temperature and reduction in relative humidity by the end of February, which result sudden rise in the pest insanity. Average temperature and relative humidity varied between 19.1 to 29.91^{0}c and 51.41 to 65.85 percent during March, respectively, which supported the pest multiplication in reaching well above the threshold level. Highly significant positive correlation (r= 0.7012-0.7737) was obtained between the larval intercity and average temperature, while the average relative humidity played a significant role on the multiplication of this pest showing the simple correlation value ® between- 0.5195 to -0.6333 (Table-1). Rainfall and wind velocity exhibited insignificant negative (r=-0.1517 to -0.2415) and positive (r=0.1570 to 0.74342) impact on the pest multiplication, respectively. However, the evaporation rate could play significant positive role (r= 0.5405 to 0.7007) on the pest intensity, when the crop was sown during 3rd week of November. Similarly, the sun shine above 6.9 hrs/ day helped the pest multiplication in the crop sown during 2nd fortnight of November (r=0.5283 to 0.5916).

Thus, the average temperature, relative humidity, evaporation rate and sunshine hours ranging between 19.1 to 29.91^{0}c, 51.42 to 65.85^{0}c percent 0.972 to 1.8 mm/ day and 6.92 to 9.14 hours / day were found conducive for the pest multiplication of gram pod borer, respectively. These results are in accordance with those of Dahiya *et al*. (1997) [4], who reported that temperature between 19 to 28^{0}c and relative humidity 51 to 58 percent were conducive for multiplication of gram pod borer (*H. armigera*) in chickpea.

Table 1: Weekly intensity (larvae/m row) of gram pod borer on chickpea varieties sown at different days

Varity	Sowing Date	Intensity (Larvae/m row) of gram pod borer on chickpea varieties sown at different dates																			Mean ±SD
		December				January				February				March				April			
		49	50	51	52	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Udai (KPG-59)	Nov. 11,2007 (D1)	0.0	O.2	0.8	1.0	0.9	0.8	0.8	0.6	0.5	0.7	0.7	0.9	1.1	1.3	1.4	2.1	2.9	1.7	1.1	1.03± 0.65
	Nov. 28,2007 (D2)	0.0	0.4	1.2	1.5	1.0	0.8	0.7	0.7	0.6	0.8	0.9	1.0	1.3	1.6	2.3	4.2	6.6	3.4	1.2	1.59± 1.54
Avarodhi	Oct.27, 2007 (D1)	0.0	0.2	0.6	1.0	0.8	0.6	0.6	0.5	0.5	0.7	0.8	0.9	0.8	0.9	1.4	0.4	0.0	0.0	0.0	0.56± 0.38
	Nov.17, 2007 (D2)	0.0	0.2	1.1	1.5	1.1	0.8	0.7	0.6	0.5	0.6	0.8	1.0	1.2	1.5	1.8	2.7	3.0	2.1	1.2	1.17± 0.76
Pargati	Nov.17, 2007 (D1)	0.0	0.3	1.0	1.2	1.0	0.8	0.6	0.4	0.4	0.7	1.0	1.2	1.7	2.4	1.8	3.4	3.6	2.5	1.0	1.31± 0.98
Mean±SD		0.0	0.26 ±0.08	0.94 ±0.21	1.24 ±0.22	0.96 ±0.10	0.76 ±0.08	0.68 ±0.07	0.56 ±0.10	0.50 ±0.06	0.07 ±0.06	0.84 ±0.10	1.0 ±0.10	1.22 ±0.29	1.54 ±0.49	1.46 ±0.62	2.56 ± 1.28	3.22 ±2.10	1.94± 1.12	0.9± 0.45	

Table 2: Simple Correlation Coefficient (r) between larval intensity on chickpea verities sown at different dates and whether factors.

Variety	Sowing Date	Temperature (0c)			Relative Humidity (%)			Rainfall (cm)	Wind velocity (km/hr)	Evoparation rate (mm/day)	Sunshine hours (hrs/day
		Maximum	Minimum	Average	Maximum	Minimum	Average				
Udai (KPG-59	Non.11, 2007(D1)	0.7180***	0.6665**	0.7012***	-0.6383**	-0.3442	-0.5664*	-0.2287	0.1570	0.5405*	0.4302
	Non.28, 2007(D2)	0.7803***	0.3615	0.7599***	-0.6543**	-04644*	-0.6333**	-02012	0.2842	0.2421	0.5283*
Avrodhi	Oct.21, 2007(D1)	0.4261	0.2947	0.4072	-0.3606	-0.4589*	-03631	-01517	0.4342	0.2817	0.3851
	Nov.17 2007(D1)	0.7795***	0.6169**	0.7424***	-0.6129**	-0.4318	-.5956**	-0.2415	0.2313	0.6250**	0.5683*
Pargati	Nov.17 2007(D1)	0.8056***	0.7188***	0.7737***	-0.3233	-0.3470	-0.5195*	-0.2382	0.2273	0.7007	0.5916**
Mean		0.7019	0.5317	0.67688	-0.51788	-.04092	-.5355	-.2123	0.2668	0.4778	0.5007

NB: *, **& *** Significant at 5%, 1% and 0.1 % level of significance, respectively

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