Short communication
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Effect of chemical sprays and weather parameters on virus infestation in green gram grown in receding soil moistures

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Climate affects not just agricultural crop growth but their associated pests and diseases as well. It also influences the distribution and proliferation of causative organisms like fungus, bacteria, virus and pests through possible alteration of host-pathogen relationship at physiological level (Colhoun, 1973). The phylogenetic and ontogenetic development and adaptation of virus carriers are dependent on changes in climate and weather. The extent of damage on crop growth and yield depends on the growth stages at which infection takes place as well as the magnitude of proliferation of the symptoms. In India after paddy harvest, short duration crops like green gram is grown in the paddy fallow fields. The crop grows utilizing the residual moisture and crop is harvested before the onset of drought. In green gram virus infestation causes reduction in quality and quantity of the produce. So an experiment was conducted to assess the effect of chemical sprays on growth and yield of green gram. This paper discusses the effect of chemical sprays and weather on virus infestation and yield in green gram.

Green gram (*Phaseolous auroues L*) var K-56 was sown in receding soil moistures at two different dates of sowing D_1 (1/02/2000) and D_2 (12/02/2000) at Deras farm of WTCER Bhubaneswar located at a latitude 20°N and 85°38'E longitude . The seeds were treated with *Rhizobium* culture before sowing. The soil was clay loam. The experiment was laid out in randomized block design with three replications and five treatments. The plot size was 5 x 4 m with 1000 plants per plot. The crop was sprayed with salicylic acid 50 ppm (T_3), cycocel 100 ppm (T_4), kaolin 6% (T_5), water (T_2) and no spray control (T_1) at 30 DAS. The virus emergence was monitored regularly. The typical symptom of mosaic and yellowing of the leaves was taken as the parameter for scoring the virus infested plants. The crop was finally harvested at 65 days after sowing.

Scoring for virus

The scoring for virus infestation was done at an interval of 6 days. About twenty-five plants per plot were randomly selected and the number of plants showing virus infestation symptoms was counted. Plants with even one leaf having virus infestation symptom were counted as an infested plant (Walkey and Neely,1980). The percentage of the infested plants was calculated. Based on the percentage of infestation, the plants were graded on 5 point scale, if 0-20% then a grade 1 was given, likewise 21-40% (grade 2), 41-60%

(grade 3), 61-80% (grade 4), 81-100% (grade 50) were given.

The virus infestation stages were divided into 2 distinct phases. i.e (i) emergence phase (ii) peak infestation phase.

Weather parameters were recorded with an automatic weather station (OMNIDATA). Soil moisture of the experimental plot was estimated gravimetricaly throughout the crop season and expressed on volume basis. The analysis of data were done as per Gomez and Gomez (1984).

Relationship between virus infestation and weather parameters

The first appearance of virus infestation symptoms was noticed around 12th March. It kept low for 10 days after which it started to build up and reached a peak during last week of March. The infestation never declined because, virus once affected does not get eradicated, and so two important phases i.e. emergence and peak infestation were identified for analysis.

The emergence of virus infestation was observed in first date of sowing (D_1) and second date of sowing (D_2) when average maximum and minimum temperatures during emergence phase were 33 to 35°C and 17.3 to 23.1°C respectively. The maximum relative humidity was between 98-99% in both D_1 and D_2. The solar radiation was in the range of 870 - 930 W m^{-2} and wind velocity ranged from 2.90 to 3.35 km h^{-1}. The number of plants infested during emergence phase in D_1 was up to 8-10.6% where as in D_2 was as high as 31.3% (Table 1).

The maximum and minimum temperature during peak infestation phase was 35 to 36.9°C and 28.8 to 25.5°C respectively in D_1 and D_2. Relative humidity was 98% and wind velocity ranged between 2-4 km h^{-1}. In D_1 solar radiation was between 869-906 W m^{-2}. But in D_2 it varied from 869-1058 W m^{-2}. The number of plants infested was 14.6-34.6% in D_1 and in D_2 it was 33.3-41.3% (Table 1). The percentage of infestation was significantly higher in D_2 except in treatment T_3. The schedule of spray treatment might have caused a difference in infestation rate. However response of different chemicals in controlling virus infestation warrants further investigation.

Virus infestation and phenological stages of crop

The phenological stages of the crop during emergence and peak population of virus infestation (Table 2) revealed that in D_1 the emergence of viruses was at 50% flowering and peak infestation during 90% pod formation stage. In D_2 emergence of virus were at 10% flowering and peak infestation occurred at pod initiation. In general at any given time D_1 had fewer infected plants as compared to D_2. In D_1 the plants were infested slowly whereas in D_2 the infestation was very rapid. Among the chemical treatments salicylic acid treated plants were infested with virus to a lesser degree. The degree of infestation measured in terms of severity of disease (Table 3) also support these results. Thus effect of salicylic acid spray in reducing virus infestation appears to be important. Salicylic acid has been reported to inhibit

Table 1 : Effect of chemical sprays and date of sowing on percentage of infestation

Treatments	Emergence (%)		Peak infestation (%)	
	D_1	D_2	D_1	D_2
Control(T_1)	8.0	24.0	29.3	38.6
Water spray(T_2)	10.6	31.3	34.66	33.3
Salicylic acid (T_3)	6.6	30.6	14.66	41.3
Cycocel(T_4)	8.0	25.33	17.33	39.3
Kaolin(T_5)	8.0	25.33	21.33	37.3

D_1 and D_2 are dates of sowing 1/02/2000 and 12/02/2000 respectively

Table 2 : Phenological stage of crop in which virus infestation occurred

Stage of virus	D_1	D_2
Emergence	38-43 DAS (50% Flowering)	28-31 DAS (10% flowering)
Peak infestation	55-58 DAS (90% pod formation)	40-45 DAS (Pod initiation)

Table 3 : Severity of virus diseases as affected by chemical sprays and date of sowing

Treatment	D_1		D_2	
	Emergence	Peak	Emergence	Peak
Control(T_1)	20	40	40	46.6
Water spray(T_2)	20	40	40	40.0
Salicylic acid (T_3)	20	20	40	46.6
Cycocel(T_4)	20	26	40	46.6
Kaolin(T_5)	20	26	40	46.6
CD at 5%	0.001	0.62	0.11	0.65

the replication of virus in treated plants (Hooft, 1986) and induced PR protein (Raskin, 1992), that reduced the spread and accumulation of virus (White *et al*, 1983). Thus exogenous application of salicylic acid might have reduced virus infestation in green gram in the present study.

But in D_2, effect of salicylic acid treatment was not apparent in reducing the virus infestation in green gram (Table 3). The effect of salicylic acid was possibly nullified due to the timing of the spray

Table 4: Soil moisture content ($cm^3\ cm^{-3}$) at various crop growth stages in green gram at different dates of sowing

Growth stages	D_1	D_2
Sowing	0.266	0.266
10% flowering	0.187	0.168
50% flowering	0.168	0.150
Pod initiation	0.150	0.132
90% pod formation	0.132	0.109

Table 5: Correlation between weather parameters and virus infestation

Weather parameters	Emergence		Peak Infestation	
	D_1	D_2	D_1	D_2
T_{max}	0.90 **	0.45	0.38	0.68
T_{min}	0.69 **	0.43	-0.02	0.42
$Solar_{max}$	0.86 **	0.73 **	-0.27	0.36
RH_{max}	0.18	-0.83 **	-0.58	-0.42
Wind velocity	0.85 **	0.83 **	0.61 **	0.77 **

*,** significant at 5% and 1% respectively, n = 15

schedule. In D_1 spray occurred before the onset of virus infestation. So plants could induce PR protein synthesis, thus reducing the spread of virus. But in D_2 the spray was after the emergence of virus. At this stage, possibly plant could not have effectively produced PR proteins or the induction of protein synthesis might have been late for reducing the virus spread. Moreover, the soil moisture content at 0-45 cm depth was 0.132 $cm^3\ cm^{-3}$ at peak infestation stage in D_2 (Table 4) and it was close to permanent wilting point (0.121-$cm^3\ cm^{-3}$) indicating a water stress. The effect of salicylic acid to improve growth and yield in green gram under multiple stress condition needs further investigation.

The yield was less in all treatments in D_2 as compared to D_1. The emergence and peak infestation of viruses coincided with flowering and pod initiation stage in D_2 (Table 2). The lesser yield observed in D_2 in comparison with D_1 could also be attributed to the crop stages in which virus was infested (Fig 1). In D_1 attack of virus was well ahead of reproductive stage. The increase in yield due to salicylic acid spray was detailed as the effect of salicylic acid to alter the permeability with in the plants resulting in more partitioning of reserves to developing pods (Raskin, 1992).

The correlation coefficient between different available weather parameters and virus infected plants were derived. The

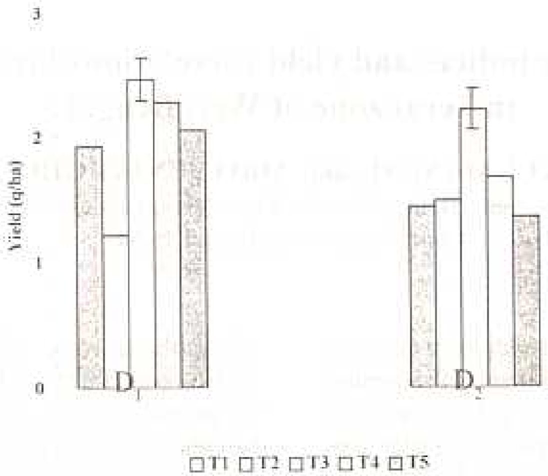

Fig 1: Yield in green gram as influenced by sowing dates and chemical sprays

maximum temperature, minimum temperature, maximum relative humidity, solar radiation and wind velocity was found to have significant correlation with virus emergence (Table 5). Dry and hot climate favours the growth and the spread of virus carriers and multiplication of virus. Thus it is clear that outbreak of virus emergence is dependent on the weather. Further studies are required to identify a spray schedule of salicylic acid based on day to day weather in relation to virus population build up.

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