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NATURAL INCIDENCE OF MOSAIC DISEASE OF PUMPKIN (*Cucurbita moschata*) AND ITS MANAGEMENT THROUGH AVOIDANCE

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ABSTRACT

Common mosaic is the most destructive disease of pumpkin in West Bengal, causing a considerable amount of damage to crops. Experiments were conducted on the natural incidence of pumpkin mosaic and their management under the agro-ecological condition of the lateritic zone of West Bengal during the season of 2015-2016.An incidence range of 16.85% - 61.16% common mosaic and a range of 8.25% - 18.10% incidence of yellow vein mosaic were observed according to the location and variety. The impact of a standard mosaic of pumpkin was found to be significantly influenced by changing the date of sowing. Late sowing of crop significantly reduced the disease and reached at the minimum level of 29.60% in the field which was sown after 30 days late of the scheduled time of sowing i.e. the second week of November. An increase of 8.68% in yield was recorded with 10 days late sowing crop. Significant differences existed among the various dates of sowing regarding yield. The percentage of yield reduction was varied from 39.02 to 49.25%, and overall an average of 45.56% reduction in pumpkin yield was noticed due to the infection of common mosaic disease.

Keywords: Pumpkin mosaic, incidence, management, time of sowing.

INTRODUCTION

The common mosaic disease of pumpkin is caused by several pathogens or viruses such as *Cucumber mosaic virus* (CMV), *Watermelon mosaic virus 2* (WMV2), *Papaya ringspot virus-watermelon strain* (PRSV-W) (Kumar, 2008, Hydarhejad, 2009) and *Zucchini yellow mosaic virus* (ZYMV). *Cucumber mosaic virus* has an almost unlimited host range, and it is reported that CMV infects more than 1200 plant spp in more than 100 plant families including dicots and monocots, ornamentals, weeds, and woody species and more than a half of these plants are natural virus hosts (Zitter and Murphy, 2009, Schemelzer et al., 1997). In India, the disease was first reported by Raychaudhuri and Varma (Raychaudhuri and Varma, 1975) and identified the aphid vectors (*Myzus persicae* and *Aphis gossypii).*

Yellow vein mosaic is also a severe menace to pumpkin crop. It has been reported from many parts of the country including West Bengal. Diseased plants show vein yellowing, which sometimes coalesces to form chlorotic patches. Infected plants are stunted, and flowers drop prematurely, significantly reducing yields. A begomovirus infects diseased plants, designated *Pumpkin yellow vein mosaic virus* (PYVMV), which is transmitted readily

and in a persistent manner by the whitefly, *Bemisia tabaci* (Muniyappa, 2003). Plant viruses cause considerable damage to various cucurbits including pumpkin. Nearly, 30 viruses are known to infect cucurbit crops under field conditions (Lovisolo, 1980). Viral diseases result in losses through a reduction in growth and yield and are responsible for distortion and mottling of fruits, making the product unmarketable. Leaves of virus-infected plants often appear mottled and distorted.

The extent of crop loss due to virus disease is highly correlated with the crop growth stage at which the virus becomes established in the field. Pumpkin plants infected early in their development (near or before the time of flowering) are severely affected and produce few fruits, and most of the pumpkins that are produced are likely to be misshapen or off-colour. However, plants infected after fruit reach full-size may not show any effect on yield or quality (Richard and Karen 1999). Hundred percent infection of the mosaic disease in pumpkin during the end of the growing season at Delhi region was reported by (Raychaudhuri and Varma, 1975). Tripathi and Joshi, 1985 reported 30 to 70 percent disease incidence of mosaic disease in pumpkin caused by WMV in Basti district, Uttar Pradesh. The primary recommendation for managing pumpkin virus diseases is to maintain proper isolation of crop from other cucurbit crops to minimise the spread of infected aphids into a pumpkin planting (Brust and Verts, 2010). A significant effect of planting date on the incidence of yellow vein mosaic of cucurbits in Central Texas and Oklahoma was reported by (Brown, 2003).

Considering the potentiality of the spread of mosaic disease of pumpkin and its annual recurrent, the present investigation has been undertaken with a view to study the natural incidence of mosaic diseases of pumpkin and the losses caused by them and to explore the possibilities of managing pumpkin viral disease through a change of date of sowing.

MATERIALS AND METHODS

Selection of Observation Area

The field experiments were conducted at a farmer's field of village, Raipur, Bolpur, Birbhum, West Bengal, during the winter season of 2015-2016 on the pumpkin (*Cucurbita moschata*). Climatic conditions of the experimental area are sub-humid and subtropical. The texture of soil was sandy loam, with a high percentage of sand and low percentage of clay.

Cultivation Technique

Land preparation

The experiments were conducted on medium upland with adequate drainage facilities. Before sowing of seeds, the land was prepared adequately with four ploughing and 15 to 20 t/ha farmyard manure (FYM). The land was finally prepared by removing the undecomposed debris of the previous crop as well as the weed and was correctly labelled.

Application of manures and fertilisers

After the land preparation, the soil was enriched with recommended doses of nitrogen, phosphorus and potassium. The recommended doses of nitrogen, phosphorus and potassium were applied in the ratio of 30:80:80 kg / ha. Mustard cake at a rate of 300 kg/ha. was also added in field 21 days after sowing. The full amount of P and K were applied as basal dose. One half of N dose in the form of urea was applied as basal dose, and other half was used at the time of first irrigation.

Design of the experiment

Experiments were conducted at Raipur farmer's field and accordingly layout and design were fixed separately for each of the experiment. To study the effect of date of sowing against a mosaic disease of different six pumpkin varieties i.e. Chaitali, Pusa-Shrabani, Kumra, Chandipur-25, Pusa-Padini and Rani-Round were shown following the Randomized Block Design with four replications for each treatment.

Survey on the natural incidence of pumpkin mosaic disease

The survey on the prevalence of pumpkin mosaic disease was conducted in various districts of a lateritic zone of West Bengal during pre-Kharif season of 2015 and 2016. Pumpkin is one of the most popular vegetable crop grown throughout the districts of a lateritic belt and known to suffer from virus disease, which causes severe losses to the farmers. To conduct this survey, farmers field of important pumpkin-growing areas i.e. Suri, Saithiya, Raipur, Binuria, Ilambazar, Bankura and Purulia were selected where pumpkin is extensively grown. In each place, field of more or less uniform size was selected at random. In each field 150 plants were selected for observation particularly to record the incidence of the diseases. For this, in each field 15 rows were selected at random, and finally, 10 plants were chosen from each row by a simple random method for observation. The numbers of infected plants were recorded. The observations were taken at 120,135 and 150 days after sowing.

Insect transmission and confirmation of pumpkin mosaic disease

Pumpkin plants were raised separately under insect-proof condition in earthen pots, aphids vectors of pumpkin common mosaic disease i.e. *Myzus persicae* and *Aphis gossypii* were multiplied in healthy pumpkin plants and their non-infectiousness was confirmed by feeding them in healthy pumpkin plant and accordingly, a healthy aphid population was propagated and maintained. Infected plants of pumpkin showing typical symptoms of common mosaic were collected from the experimental field and these plants were kept with healthy aphids for acquisition feeding of two hours with the help of tube and aspirator. The aphids were given one-hour pre-acquisition fasting. After acquisition feeding, the viruliferous aphids were released on healthy pumpkin plants for transmission feeding for 24 hours. After the stipulated time of transmission/ inoculation feeding the plant was sprayed with 1% Metasystox and kept the plants under insect-proof condition for symptoms development. Finally, the symptoms were compared with the common mosaic symptoms observed in the pumpkin field on the basis of common characters. The identification of the virus of common mosaic of pumpkin (CMV) and (WMV2) was done by indicator host (Davis and Mizuki, 1987).

Effect of date of sowing on the incidence of pumpkin mosaic disease

To study the effect of date of sowing on the incidence of mosaic disease of pumpkin in field, common variety Chaitali was selected during the investigation at Raipur farmer's field. The dates of sowing were fixed on the basis on schedule time of sowing date i.e. second week of November, generally being followed by the farmers in lateritic belt of West Bengal and in present study it was taken as 9.11.2015 and served as control. Accordingly, different dates were fixed with 10 days intervals from the scheduled date of sowing viz. 10 days early, 20 days early, 10 days late , 20 days

late and 30 days late. To record the initial infection of mosaic disease in field, all plants were examined properly after sowing. Incidence of the pumpkin mosaic disease was recorded at an interval of 15 days after appearance of first disease symptoms. Accordingly, data on the interval between the date of sowing and the appearance of first symptoms and total interval were recorded. Apparent infection rate of spread of the disease was calculated according to the following formula (Van der Plank, 1983).

$$R = \frac{2.3}{t_2 - t_1} \left\{ \text{Log} \left(\frac{X_2}{1-X_2} \right) - \text{Log} \left(\frac{X_1}{1-X_1} \right) \right\}$$

Where, r = Apparent infection rate at exponential growth stage, t_1 = First day of observation, t_2= Last date of observation, X_1 = Production of the disease on first day of observation, X_2= Production of the disease on last day of observation

Yields of all treatments were recorded separately after full maturity of crop.

RESULTS AND DISCUSSION

Survey on the Natural Incidence of Pumpkin Mosaic Disease

Survey was conducted during the pre Kharif season of 2015-2016 in different locations of lateritic belt i.e. Birbhum, Bankura and Purulia districts to get information on the natural incidence of mosaic disease of pumpkin (*Cucurbita moschata*) at farmers' fields. The data obtained on the incidence of the disease from various locations are presented in Table 1. It was evident from the table that the incidence of pumpkin mosaic diseases i.e. common and yellow vein mosaic was varied according to the location and variety. Common mosaic was the most prominent disease of pumpkin plants cultivated in the lateritic belt of West Bengal. An incidence range of 16.85% to 61.16% of the common mosaic was obtained from different locations. Maximum incidence 61.16% was recorded from the farmer's field of Binuria, Birbhum followed by 59.32% from Raipur, Birbhum on variety Chaitali and 54.85% from Saithiya, Birbhum on the variety Pusa-padini. The incidence level of common mosaic was found less in Bankura and Purulia districts i.e. 16.85% and 33.57% respectively from variety Kumra and Chaitali .A range of 8.25% to 18.10 incidence of yellow vein mosaic (very common in Western U.P. and Northern India) was also reported from lateritic belt of West Bengal. However, higher incidence of yellow vein mosaic was noticed in Bankura and Purulia districts in comparison to Bhirbhum district was probably due to the higher average of maximum and minimum temperature congenial for the population build-up of vector *Bemicia tabaci*. High incidence of yellow mosaic 18.10% was recorded from the farmer's field of Bankura district. The disease was generally appeared in field at about 100 DAS and very little amount of infection (1.78 to 8.24%) was observed at 120 DAS. But, the incidence was increased very rapidly during next 15 days and reached up to the level of 37.8% was probably due the presence of maximum number of vectors (*Myzus persicae, Aphis gossypii* and *Aphis craccivora*), very common in potato and mustard fields during that period. Genetic characters of the cultivar Kumra and less vector population could be the reason of minimum incidence of mosaic disease in Bankura District (Figs. 2 and 3).

Effect of Date of Sowing on the Incidence of Pumpkin Mosaic Disease

An attempt was made to know the effect of different date of sowing on the incidence and spread of common mosaic disease of

pumpkin. The experiment was conducted on cultivar Chaitali at Raipur, Birbhum farmers' field. Observations on various parameters i.e. disease incidence, yield etc. were taken at a regular interval and the data have been presented in the Table 2. The incidence of a common mosaic of pumpkin was found to be influenced greatly by changing the date of sowing. The incidence of disease was found to be increased with the early sowing. While, it was declined considerably with the late sowing of crop from schedule time of sowing i.e second week of November, generally being followed by the farmers in lateritic belt and in present study it was 9.11.2015 which served as control. Maximum incidence of common mosaic 75.80% was recorded from the field shown 20 days earlier than the schedule time followed by 69.18 % from 10 days which exhibited 21.572% and 10.954% increase in common mosaic incidence respectively. The disease was reduced greatly by late sowing of crop and reached the minimum level of 29.60% in 30 days late sowing crop. A range of 21.957% to 52.526% reduction in disease incidence was observed over control. Maximum reduction in disease incidence (52.526%) was observed when the crop was sown after 30 days (09.12.2015) of schedule time i.e. 9.11.2015 followed by 20 days (38.653%) and 10 days (21.957%). Significant differences were exist among the different dates of sowing in terms of disease incidence. In all cases the disease was appeared in the field in between 110 to 120 DAS irrespective of their different date of sowing. There was no correlation observed between time taken for developing first symptoms in field and level of incidence and date of sowing (Fig. 4). The infection rate of common mosaic was found maximum (0.084) in the field shown on scheduled time i.e. 09.11. 2015, and it was observed little lesser in the fields shown 10 to 20 days earlier than the scheduled time of sowing which were exhibited 0.076 and 0.061 respectively. Yield obtained from the fields of different sowing dates was also taken as a component of comparison. Maximum yield (17.78 tonnes/ha) was obtained from the field sown 10 days after the schedule time of sowing followed by (17.45 tonnes/ha) from 20 days, contributed 8.680% and 6.663% increase in yield respectively. However, the yield was declined 1.589%

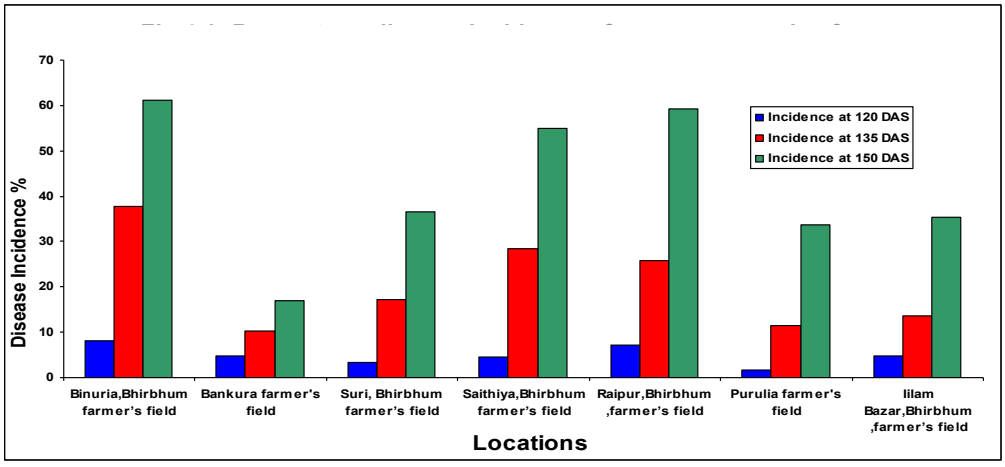

Fig. 1. Percentage disease incidence of common mosaic of pumpkin at various locations of lateritic belt

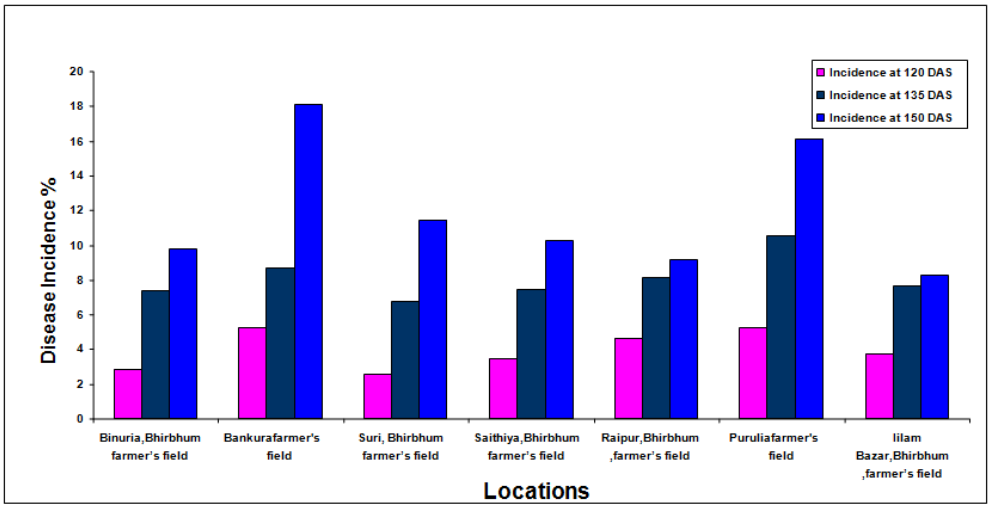

Fig. 2. Percentage disease incidence of Yellow vein mosaic of Pumpkin at various locations of lateritic belt

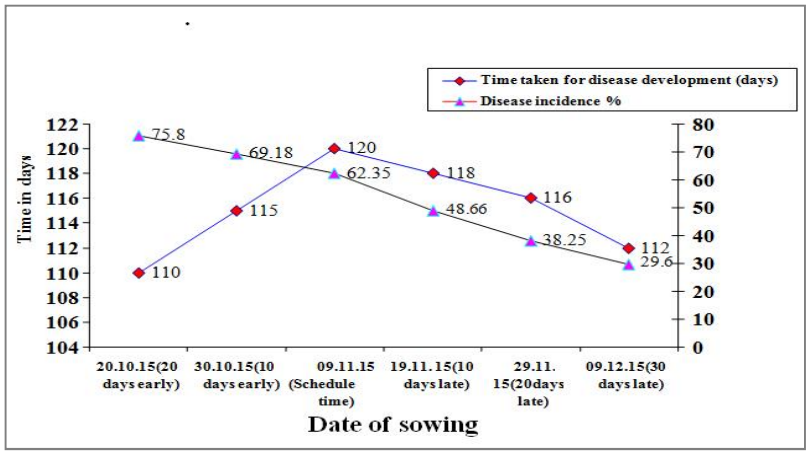

Fig. 3. Relationship between time taken for disease development, incidence and date of sowing

when the crop was sown on 09.12.2015 i.e. 30 day after the schedule time. Significant differences were exist among the various dates of sowing in terms of yield. Though the late showing of crop performed well in terms of disease incidence and reduced the disease up to 52.526% in 30 days of late sowing but, after a certain level it contributed negatively towards the yield was probably due to the improper weather crop relationship as high temperature, moisture stress condition, other biotic factors etc. during summer are the determinants of crop yield. Similar trend in yield was also noticed with the early sowing of crop and 2.506% and 6.907% reduction in yield was

Table 1. Natural Incidence of pumpkin mosaic disease in different location of Lateritic zone of West Bengal

Sl. No	Locality	Variety grown	Area in sq. meter	Date of sowing	No. of plant obser-ved	Disease Incidence %					
						Incidence of common mosaic disease			Incidence of yellow vein mosaic disease		
						120 DAS	135 DAS	150 DAS	120 DAS	135 DAS	150 DAS
1.	Binuria, Bhirbhum Farmer's field	Chaitali	850	01.11.2015	150	8.24	37.85	61.16	2.84	7.35	9.76
2.	Bankura Farmer's field	Kumra	925	10.11.2015	150	4.83	10.26	16.85	5.25	8.64	18.10
3.	Suri, Bhirbhum Farmer's field	Chandipur	1000	06.11.2015	150	3.37	17.24	36.59	2.56	6.78	11.45
4.	Saithiya,Bhirbhum Farmer's field	Pusa-padini	900	31.10.2015	150	4.46	28.35	54.85	3.51	7.42	10.24
5.	Raipur, Bhirbhum Farmer's field	Chaitali	1200	04.11.2015	150	7.25	25.75	59.32	4.62	8.10	9.12
6.	Purulia Farmer's field	Chaitali	1000	08.11.2015	150	1.78	11.56	33.57	5.23	10.49	16.12
7.	Iilam Bazar, Bhirbhum Farmer's field	Rani -round	1000	12.11.2015	150	4.68	13.66	35.45	3.75	7.64	8.25

Table 2. Effect of date of sowing on the incidence of pumpkin mosaic disease

Sl. No.	Date of sowing	Time taken for developing 1st disease symptoms in field	Date of 1st appearance of disease symptoms in field	Date of final incidence of the disease	Incidence range %	Final Disease Incidence (%)	Apparent infection rate of the disease	% Reduction /increase in disease incidence over control	Yield tones /ha	% Reduction /increase in yield
1.	20.10.2015	110 days	07.02.2016	15.04.2016	4.80- 75.80	75.80	0.061	+21.572	15.23	-6.907
2.	30.10.2015	115 days	22.02.2016	18.04.2016	3.25 - 69.18	69.18	0.076	+10.954	15.95	-2.506
3.	09.11. 2015	120 days	09.03.2016	25.04.2016	3.08 - 62.35	62.35	0.084	0.000	16.36	0.000
4.	19.11. 2015	118 days	17.03.2016	30.04.2016	2.33 – 48.66	48.66	0.083	-21.957	17.78	+8.680
5.	29.11. 2015	116 days	25.03.2016	02.05.2016	2.80- 38.25	38.25	0.080	-38.653	17.45	+6.663
6.	09.12.2015	112 days	31.03.2016	05.05.2016	2.20 - 29.60	29.60	0.083	-52.526	16.10	-1.589
SE (treatment mean) =		*1.69*	*1.66*	*0.000183*	*0.121*					
CD at 5%		*= 5.09*	*5.02*	*0.000550*	*0.366*					

obtained with 10 days and 20 days early sowing respectively. High population of vectors (*Myzus persicae, Aphis gossypii* and *Aphis craccivora*) during October – November could be the main reason of higher incidence of mosaic disease in early shown crops which resulted in poor yield (Figs. 4 and 5).

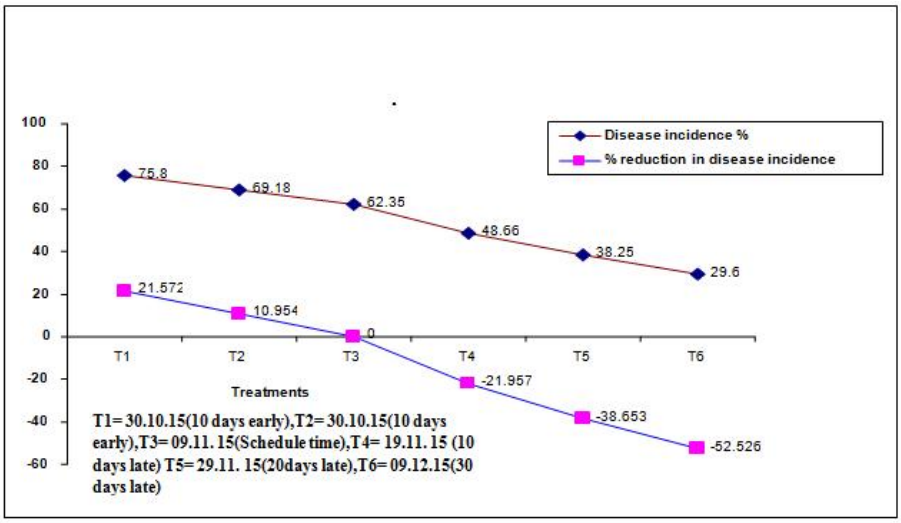

Fig. 4. Effect of date of sowing on the incidence of disease and their respective% increase /decrease in disease incidence

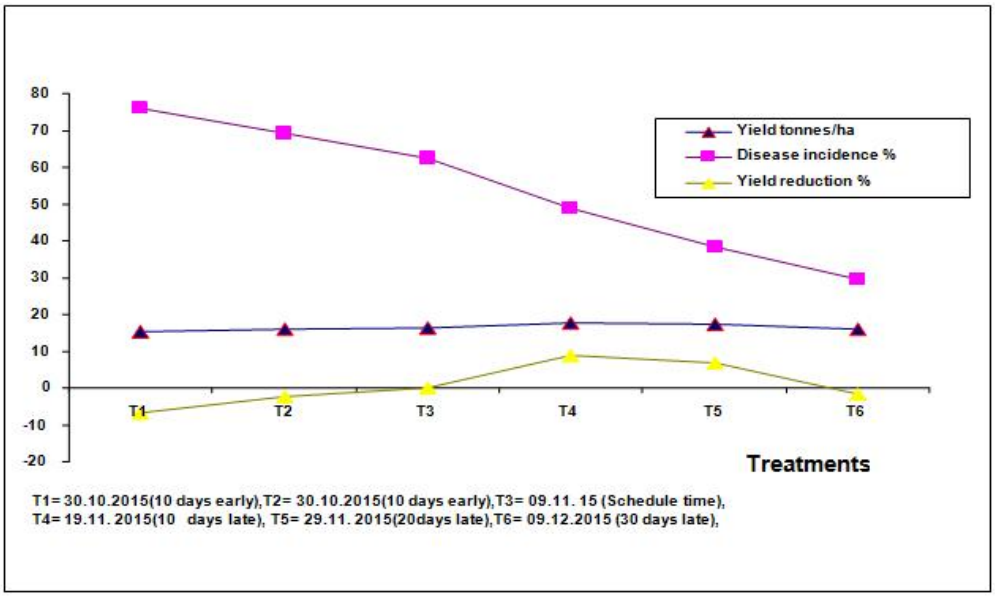

Fig. 5. Relationship in between date of sowing, disease incidence and yield

CONCLUSION

One of the major constraints of pumpkin cultivation is that, the crop is infected by a number of viral diseases in which mosaic disease (common mosaic, pumpkin yellow vein mosaic) is very common and destructive in West Bengal, causing considerable damage to the crop. An incidence range of 16.85% to 61.16% of the common mosaic was obtained from different locations. A range of 8.25% to 18.10 incidence of yellow vein mosaic (very common in Western U.P. and Northern India) was also reported from lateritic belt of West Bengal. The incidence of common mosaic of pumpkin was found to be influenced greatly by changing the date of sowing. The incidence of disease was increased with the early sowing. While, it was declined considerably with the late sowing of crop from schedule time of sowing i.e. the second week of November. Maximum incidence of common mosaic 75.80% was recorded from the field sown 20 days earlier than the schedule time. The disease was reduced greatly by late sowing of crop and reached the minimum level of 29.60% at 30 days late sowing. So, it is concluded that delayed sowing of seeds by 30 days would help the farmer by decreasing their yield loss.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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