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EFFECT OF PLANTING DATES ON INSECT PEST INCIDENCE ON PADDY IN GALL MIDGE ENDEMIC AREA OF EASTERN VIDARBHA REGION OF MAHARASHTRA

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ABSTRACT

Trial on effect of planting dates on pest incidence was conducted at Agriculture Research Station, Sakoli, Dist. Bhandara during *kharif* 2013, 2014 and 2015 with an objective to study the influence of date of planting on insect pest incidence and population dynamics in paddy crop. Incidence of gall midge, stem borer, leaf folder, brown plant hopper, white backed plant hopper and green leaf hopper was recorded in these trials. The results revealed that, there was no significant difference noticed in case of incidence of stem borer in different planting. Low incidence of leaf folder, brown plant hopper, white backed plant hopper and green leaf hopper were recorded in different plantings. However, early planting significantly reduced the incidence of gall midge followed by normal planting and highest incidence was exhibited in late planting. The highest yield was obtained in normal planting and at par with early planting and the lowest in late planting. Similarly, Benefit : Cost ratio of 1:1.53 in normal planting was closer to early planting (1:1.43) and lowest in late planting (1: 0.84). Thus, early planting compared favorably with normal planting and stands effective in terms of yield and Benefit : Cost ratio.

(Key words: Rice, effect of planting dates, insect pests incidence)

INTRODUCTION

Rice (*Oryza sativa* L.) is the staple food of more than half of the human population. In India, rice grows in about 43.9 million ha area with a production of 104.8 million tones and productivity of 2390 kg ha^{-1} (rice) during 2015-16. The total area in Maharashtra state was 15.57 lakh ha with annual rice production of 36.54(52.95 rough rice) lakh tones and the average productivity was 2.35 (3.40 rough rice) tones ha^{-1} during 2015-16. The area under rice crop in Bhandara district was 1,72,950 ha with productivity of 2199 kg ha^{-1} (rice) during *kharif* 2016. There is need to further enhance the rice production, but a number of abiotic and biotic stresses are the main constraints. Sakoli is an endemic area for gall midge incidence. Standing water, cloudy weather and drizzling rains favours gall midge buildup. Intensive cultivation of rice has resulted in the frequent occurrence of biotic stresses that formed as major constraints in rice production. Weather condition influence the various growth and development stage of crop and indirectly, the incidence of pests and diseases (Yoshida and Parao, 1976). A combination of cultural practices like early planting, synchronous planting, crop rotation and early maturing varieties protect the rice crop against most insect pest and diseases (Litsinger *et al*., 1987). In recent times climate change had impact on the onset and progress of the monsoon across the country. Early and delaying of onset of monsoon has affected farmer's planting of rice crops. Similarly, variability in the distribution pattern of rainfall, unavailability of water source and subsequent release of water from canals is forcing farmers to plant rice at different dates. These changes in sowing and planting dates have profound influence on the incidence of biotic stresses mainly insect pests. Earlier efforts have been made to study the influence of date of planting on insect pest incidence and population dynamics in rice crop by ICAR- Indian Institute of Rice Research, Hyderabad and others (Karuppuchamy and Gopalan, 1986, Umeh, 1998, Magunmder *et al.,* 2013, Singh *et al.,* 2013, Anonymous, 2013, 2014, 2015 and 2016, Tetarwal *et al.,* 2014). Hence, the trials were conducted with the objective to study the influence of date of planting on insect pest incidence and population dynamics at Agriculture Research Station, Sakoli, Dist. Bhandara (M.S.) during *kharif* 2013 to 2015.

MATERIALS AND METHODS

Most popular variety PKV HMT was planted at three dates *viz.*, normal planting - as per the recommended package of practices of the region, early planting - 15 days

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earlier to normal planting and late planting - 15 days later than the normal planting. The date of sowing was decided on the basis of expected date of onset of monsoon in the respective years. The field experiment consisted of three treatments and ten replications were laid out in randomized block design (RBD) with spacing of 20 cm X 15 cm and plot size of 500 m^2. 1500 m^2 area was divided into 3 plots of 500 m^2. Each time nursery sowings and plantings were done separately in 500 m^2 area. Observations on insect pest incidence were recorded at 10 days interval starting from 10 days after transplanting. Incidence of gall midge, stem borer, leaf folder, brown plant hopper, white backed plant hopper and green leaf hopper was recorded in all the plantings on PKV HMT grown in this trial.

Time of sowing, planting and harvesting (3 dates of planting) were as follows -

Treat. No.	Treatments	Sowing date			Transplanting date			Harvesting date		
		2013	2014	2015	2013	2014	2015	2013	2014	2015
1	Early planting	1.7.13	23.6.14	5.6.15	20.7.13	14.7.14	2.7.15	15.11.13	5.11.14	2.11.15
2	Normal planting	15.7.13	8.7.14	22.6.15	5.8.13	30.7.14	17.7.15	27.11.13	20.11.14	18.11.15
3	Late planting	1.8.13	23.7.14	7.7.15	21.8.13	13.8.14	3.8.15	12.12.13	5.12.14	4.12.15

RESULTS AND DISCUSSION

Three year cumulative pooled results indicate that, high mean incidence of gall midge (8.77 – 21.74% silver shoots) was observed with significantly higher damage in late planting (21.74 % silver shoots) followed by normal planting (14.56 % silver shoots) and lowest in early planting (8.77 % silver shoots) (Table 1). There was no much more and no significant difference found in incidence of stem borer i.e. dead hearts (DH) and white ear heads (WE), respectively in different planting dates. Mean dead heart damage was low in early planting (3.43%) followed by normal planting (4.15%) and high in late planting (5.53%), while white ear damage was low in normal planting (8.17%) followed by late planting (9.32%) and high in early planting (9.93%) (Table 2). Low mean incidence of leaf folder (3.69 – 4.65 % damage), brown plant hopper (2.01 – 2.09 no. $hill^{-1}$), white backed plant hopper (2.21 – 2.50 no. $hill^{-1}$) and green leaf hopper (1.06 – 1.38 no. $hill^{-1}$) were recorded in different plantings (Table 3 to 6). Normal planting (28.03 q ha^{-1}) yielded more, was significantly superior to other treatments and at par with early planting (26.21 q ha^{-1}) and followed by late planting (14.83 q ha^{-1}). 1.82 and 13.20 q ha^{-1} higher yield was recorded in normal planting as compared to early and late planting, respectively. Similarly, yielded 6.49 and 47.09 per cent more in normal planting as compared to early and late planting, respectively (Table 8). Benefit : Cost ratio of 1:1.53 in normal planting was found superior over early planting (1:1.43) and lowest in late planting (1: 0.84) (Table 8).

From analysis of mean incidence of insect pests, the results revealed that, early planting significantly reduced the incidence of gall midge followed by normal planting and highest incidence was exhibited in late planting. No significant difference was found in incidence of stem borer in different planting. Low incidence of leaf folder, brown plant hopper, white backed plant hopper and green leaf hopper were recorded in different plantings. Highest yield and Benefit : Cost ratio was exhibited in normal planting which compared favorably with early planting (Table 9).

Occurrence of insect pests on paddy crop is influence by date of planting. In case of late transplanting the surrounding crop might have completed their susceptible growth stages and the entire pest inoculum would be feeding or confining to the late transplanted crop (Rani and Pillai, 2012). This might be the reason for higher gall midge incidence in late planted rice. Varying the planting time of crops worked as a means of cultural control by creating asynchrony between crop phenology and insect pests phenology which can retard the colonization (Ferro, 1987). Higher population was found in later stage crop. It may be occurred due to higher succulency in leaves, stem or tillers. The result of the present investigation showed that low incidence of gall midge was exhibited in early planting. Similar findings of reduced pests and diseases in early maturity variety and early transplanting date have been reported by Litsinger *et al.* (1987). Low incidence of pests and diseases in early planting date is also reported by Moniperumal (1989). Souleymane Nacro *et al.* (2006) showed that the later the planting date, the higher the damage caused by African rice gall midge (*O. oryzivora)*. Yield losses were correlated to the observed damage. Trials conducted by ICAR- IIRR, Hyderabad during *kharif* 2016 was support to the present findings where gall midge incidence was reported with highest damage of 15.84% SS at Titabar in late planting (Anonymous, 2016). A similar result was found in the present study. Similarly, Singh *et al.* (2013) revealed that the maximum damaged of stem borer and leaf folder and population $five^{-1}$ sweeps of leaf folder, green leaf hopper and grass hopper were observed in very late transplanting and least in normal planting in both experimental years. The natural populations $five^{-1}$ sweeps were highest in normal followed by very late planting rice. Magunmder *et al.* (2013) found that early planted rice had lower pests and natural enemies population than later-transplanted rice.

The data revealed that there was not much difference in other insect pest incidence in different dates of planting except gall midge which was high in late planting. Early planting was beneficial for reduction of damage of gall midge. However, the highest yield was obtained in normal planting and at par with early planting and the lowest in late planting.

Table 1. Effect of planting dates on incidence of gall midge on paddy (Pooled mean of *kharif* 2013, 2014, 2015)

Tr. No.	Treatments	% of Silver shoot at days after transplanting (DAT)											
		10	20	30	40	50	60	70	80	90	100	110	Mean
1	Early planting	0.00	1.62	3.17	5.24	6.53	10.84	13.98	12.41	11.61	11.52	5.98	8.77
		(0.00)	(1.18)	(1.70)	(2.24)	(2.53)	(3.28)	(3.73)	(3.50)	(3.40)	(3.36)	(2.43)	(2.96)
2	Normal planting	0.00	2.92	5.87	8.80	12.43	23.27	26.44	23.52	18.61	8.71	2.99	14.56
		(0.00)	(1.66)	(2.41)	(2.94)	(3.48)	(4.81)	(5.14)	(4.84)	(4.31)	(2.90)	(1.67)	(3.81)
3	Late planting	0.00	1.11	4.20	16.33	27.23	35.75	36.14	31.08	17.84	19.18	3.82	21.74
		(0.00)	(0.86)	(2.00)	(4.02)	(5.21)	(5.96)	(6.00)	(5.56)	(4.19)	(4.37)	(1.87)	(4.66)
	SE (±m)	0.00	0.17	0.16	0.16	0.13	0.11	0.11	0.10	0.11	0.16	0.12	0.04
	CD at 5%	-	0.50	0.49	0.47	0.39	0.33	0.32	0.31	0.31	0.46	0.36	0.13
	CV (%)	0.00	42.70	25.37	16.22	11.12	7.39	6.81	7.07	8.44	13.84	19.21	2.10

Figures in parentheses are corresponding values of square root (n) transformations of % of Silver shoot.

Table 2. Effect of planting dates on incidence of stem borer on paddy (Pooled mean of *kharif* 2013, 2014, 2015)

Tr. No.	Treatments	Incidence of stem borer at days after transplanting (DAT)												
		% Dead heart												% White earhead*
		10	20	30	40	50	60	70	80	90	100	110	Mean	
1	Early planting	0.00	0.56	0.45	0.44	0.11	1.84	2.48	3.10	5.90	6.87	10.15	3.43	9.93
		(0.71)	(0.99)	(0.95)	(0.95)	0.77)	(1.52)	(1.68)	(1.85)	(2.49)	(2.69)	(3.25)	(1.98)	(3.11)
2	Normal planting	0.00	0.34	0.44	0.69	2.05	2.19	3.49	6.33	6.27	9.81	6.40	4.15	8.17
		(0.71)	(0.88)	(0.94)	(1.04)	(1.59)	(1.54)	(1.98)	(2.61)	(2.57)	(3.20)	(2.61)	(2.15)	(2.83)
3	Late planting	0.00	0.21	0.73	2.63	2.34	3.51	5.98	6.68	10.98	10.43	10.69	5.53	9.32
		(0.71)	(0.81)	(1.08)	(1.72)	(1.62)	(1.94)	(2.53)	(2.67)	(3.37)	(3.28)	(3.32)	(2.45)	(3.03)
	SE (±m)	0.00	0.09	0.09	0.11	0.09	0.12	0.10	0.09	0.14	0.11	0.10	0.05	0.14
	CD at 5%	-	-	-	0.32	0.27	0.36	0.31	0.26	0.42	0.32	0.31	0.13	-
	CV (%)	0.00	30.15	28.69	27.48	21.77	23.02	15.79	11.64	15.81	11.16	10.79	6.54	14.61

* Observation of White earhead at before harvesting

Figures in parentheses are corresponding values of square root (n+0.5) (% Dead Heart) and square root (n) (% WE) transformation

Table 3. Effect of planting dates on incidence of leaf folder on paddy (Pooled mean of *kharif* 2013, 2014, 2015)

Tr. No.	Treatments	% damage of leaf folder at days after transplanting (DAT)											
		10	20	30	40	50	60	70	80	90	100	110	Mean
1	Early planting	0.00 (0.71)	0.00 (0.71)	2.36 (1.68)	5.52 (2.44)	3.14 (1.89)	5.22 (2.39)	5.22 (2.39)	5.39 (2.42)	4.31 (2.19)	4.11 (2.14)	3.86 (2.09)	4.44 (2.22)
2	Normal planting	0.00 (0.71)	0.54 (1.00)	0.84 (1.13)	1.72 (1.47)	5.42 (2.43)	4.94 (2.32)	5.82 (2.51)	5.25 (2.40)	3.53 (2.00)	3.24 (1.93)	1.88 (1.53)	3.69 (2.05)
3	Late planting	0.79 (1.09)	2.55 (1.72)	2.22 (1.64)	4.87 (2.30)	6.89 (2.71)	7.50 (2.82)	6.72 (2.68)	6.03 (2.55)	4.14 (2.13)	4.22 (2.14)	1.22 (1.30)	4.65 (2.27)
	SE (±m)	0.06	0.08	0.08	0.07	0.07	0.05	0.05	0.05	0.07	0.08	0.05	0.03
	CD at 5%	0.18	0.22	0.23	0.22	0.22	0.14	0.14	-	-	-	0.14	0.09
	CV (%)	23.07	20.85	16.77	11.15	9.81	5.93	6.04	5.93	10.75	12.77	9.38	4.21

Figures in parentheses are corresponding values of square root (n+0.5) transformation % damage of leaf folder.

Table 4. Effect of planting dates on incidence of brown plant hopper on paddy (Pooled mean of *kharif* 2013, 2014, 2015)

Tr. No.	Treatments	Population of BPH (No.hill^{-1}) at days after transplanting (DAT)											
		10	20	30	40	50	60	70	80	90	100	110	Mean
1	Early planting	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.35 (0.92)	1.30 (1.34)	1.75 (1.50)	1.85 (1.53)	3.79 (2.07)	2.79 (1.81)	2.23 (1.65)	2.01 (1.58)
2	Normal planting	0.00 (0.71)	0.00 (0.71)	0.14 (0.80)	0.78 (1.13)	1.47 (1.40)	2.06 (1.60)	3.77 (2.06)	3.59 (2.02)	2.93 (1.85)	2.69 (1.78)	1.37 (1.36)	2.09 (1.61)
3	Late planting	0.00 (0.71)	0.09 (0.76)	0.68 (1.08)	1.36 (1.36)	2.51 (1.73)	4.63 (2.26)	4.05 (2.13)	3.36 (1.96)	2.37 (1.69)	0.74 (1.11)	0.30 (0.89)	2.01 (1.58)
	SE (±m)	0.00	0.01	0.01	0.02	0.02	0.03	0.03	0.03	0.02	0.02	0.02	0.01
	CD at 5%	-	0.03	0.04	0.06	0.06	0.08	0.10	0.10	0.07	0.07	0.06	-
	CV (%)	0.00	3.99	5.06	5.93	4.39	5.13	5.79	5.91	3.72	4.70	5.01	2.19

Figures in parentheses are corresponding values of square root (n+0.5) transformation population of BPH.

Table 5. Effect of planting dates on incidence of white backed plant hopper on paddy (Pooled mean of *kharif* 2013, 2014,2015)

Tr. No.	Treatments	Population of WBPH (No. hill^{-1}) at days after transplanting (DAT)											
		10	20	30	40	50	60	70	80	90	100	110	Mean
1	Early planting	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.37 (0.93)	0.40 (0.95)	1.91 (1.55)	2.82 (1.82)	2.81 (1.82)	4.42 (2.22)	2.77 (1.81)	2.20 (1.64)	2.21 (1.65)
2	Normal planting	0.00 (0.71)	0.00 (0.71)	0.33 (0.91)	1.10 (1.26)	2.25 (1.66)	2.77 (1.80)	5.67 (2.48)	3.74 (2.06)	2.83 (1.83)	2.71 (1.79)	1.11 (1.27)	2.50 (1.73)
3	Late planting	0.00 (0.71)	0.19 (0.83)	0.88 (1.17)	1.63 (1.45)	4.11 (2.15)	4.66 (2.27)	3.89 (2.10)	3.33 (1.96)	3.26 (1.94)	0.70 (1.09)	0.35 (0.92)	2.30 (1.67)
	SE (±m)	0.00	0.01	0.01	0.03	0.02	0.04	0.03	0.02	0.02	0.02	0.02	0.01
	CD at 5%	-	0.03	0.04	0.09	0.07	0.10	0.08	0.05	0.05	0.06	0.06	0.03
	CV (%)	0.00	4.92	4.41	8.05	4.71	5.92	3.74	2.70	2.80	3.93	5.27	1.64

*Figures in parentheses are corresponding values of square root (n+0.5) transformation population of WBPH.

Table 6. Effect of planting dates on incidence of green leaf hopper on paddy (Pooled mean of *kharif* 2013, 2014, 2015)

Tr. No.	Treatments	Population of GLH (No. hill) at days after transplanting (DAT)											
		10	20	30	40	50	60	70	80	90	100	110	Mean
1	Early planting	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.14 (0.80)	0.18 (0.81)	0.68 (1.08)	1.09 (1.26)	1.07 (1.25)	2.67 (1.78)	1.37 (1.37)	1.33 (1.35)	1.06 (1.2)
2	Normal planting	0.00 (0.71)	0.09 (0.77)	0.12 (0.79)	0.45 (0.97)	0.63 (1.06)	1.44 (1.39)	2.45 (1.71)	2.52 (1.73)	1.81 (1.52)	1.64 (1.46)	0.87 (1.17)	1.20 (1.30)
3	Late planting	0.00 (0.71)	0.06 (0.75)	0.31 (0.90)	0.87 (1.17)	1.73 (1.49)	3.05 (1.88)	2.18 (1.64)	2.50 (1.73)	2.03 (1.59)	0.87 (1.17)	0.23 (0.85)	1.38 (1.37)
	SE (±m)	0.00	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.02	0.02	0.03	0.01
	CD at 5%	-	0.03	0.05	0.06	0.07	0.07	0.09	0.10	0.06	0.05	0.08	0.02
	CV (%)	0.00	3.88	6.78	6.16	6.19	4.97	6.44	6.98	4.06	4.21	7.78	1.90

*Figures in parentheses are corresponding values of square root (n+0.5) transformation population of GLH.

Table 7. Cost of cultivation in EPDP Trial

Sr. No.	Item	Cost of cultivation (Rs.) in		
		Early planting	Normal planting	Late planting
1	Cost of Seed Variety - PKV HMT Rate @ Rs.35 kg^{-1}, Seed rate : 40 kg ha^{-1}	1400	1400	1400
2	Seed Sowing + 2 labour @ Rs 180/-	360	360	360
3	Ploughing @ Rs. 3750 ha^{-1} by tractor + Driver	3750	3750	3750
4	Puddling @ Rs. 4000 ha^{-1} by tractor + Driver	4000	4000	4000
5	Transplanting (Uprooting of seedling and transplanting) 40 labour@ Rs.180day^{-1}	7200	7200	7200
6	Fertilizer application (100:50:50 kg NPK ha^{-1}) SSP (00:16:00) - 3.12 q@ Rs. 640/100kg = Rs.1997/- MOP (00:00:60) - 0.84 q@ Rs. 1700/100kg = Rs.1428/- Urea (46:00:00) - 2.17 q@ Rs. 594/100kg = Rs.1289/- + 2 labour @ Rs 180/-=360	4714	4714	4714
7	Weeding 1 times @ 30 labour ha^{-1} $weeding^{-1}$ Wages @ Rs.180 day^{-1}	5400	5400	5400
8	Harvesting @ 25 labour ha^{-1} Wages @ Rs.180 day^{-1}	2750	2750	2750
9	Bundling & Heaping@ 16 labour ha^{-1} Wages @ Rs.180 day^{-1}	2880	2880	2880
10	Threshing by paddy thresher @ 100 q^{-1} yield	2621	2803	1483
	Total	**34715**	**34897**	**33577**

Table 8. Effect of planting dates on yield of paddy and Benefit : Cost ratio (B:C Ratio)

Tr. No.	Treatments	Yield (q ha^{-1})	Increase in yield in normal planting (q ha^{-1})		Increase in yield in normal planting (%)		Gross return (Rs.)	Cost of cultivation ha^{-1} (Rs.)	Net returns (Rs.)	B:Cratio
			over early planting	over late planting	over early planting	over late planting				
1	Early planting	26.21					49799	34715	15084	1:1.43
2	Normal planting	28.03	1.82	13.2	6.49	47.09	53257	34897	18360	1:1.53
3	Late planting	14.83					28177	33577	-5400	1:0.84
	SE (±m)	1.95								
	CD at 5%	5.85								
	CV (%)	25.41								

* Rate of paddy = Rs. 1900 quintal^{-1}

Table 9. Effect of planting dates on mean incidence of insect pests, yield of paddy and Benefit : Cost ratio (Pooled mean of *kharif* 2013, 2014, 2015)

Tr. No.	Treatments	Gall midge (% Silver Shoot)	Stem Borer		Leaf folder (% Damage)	Brown plant hopper (No. hill^{-1})	White backed plant hopper (No. hill^{-1})	Green leaf hopper (No. hill^{-1})	Yield (q ha^{-1})	B:C ratio
			Dead heart (%)	White earhead (%)						
1	Early planting	8.77 (2.96)	3.43 (1.98)	9.93 (3.11)	4.44 (2.22)	2.01 (1.58)	2.21 (1.65)	1.06 (1.2)	26.21	1:1.43
2	Normal planting	14.56 (3.81)	4.15 (2.15)	8.17 (2.83)	3.69 (2.05)	2.09 (1.61)	2.50 (1.73)	1.20 (1.30)	28.03	1:1.53
3	Late planting	21.74 (4.66)	5.53 (2.45)	9.32 (3.03)	4.65 (2.27)	2.01 (1.58)	2.30 (1.67)	1.38 (1.37)	14.83	1:0.84
	SE (±m)	0.04	0.05	0.14	0.03	0.01	0.01	0.01	1.95	
	CD at 5%	0.13	0.13	-	0.09	-	0.03	0.02	5.85	
	CV (%)	2.10	6.54	14.61	4.21	2.19	1.64	1.90	25.41	

Figures in parentheses are corresponding values of square root transformation i.e (n) for gall midge and (n+0.5) for stem borer, leaf folder, brown plant hopper, white backed plant hopper and green leaf hopper.

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