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Effect of date of sowing on the incidence of stem rot of jute (*Corchorus olitorius* L.) caused by *Macrophomina phaseolina* (Tassi) Goid

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In a field experiment with different dates of sowing of jute (*Corchorus olitorius* L.) variety JRO 8432, early sown crop suffered from more stem rot, caused by *Macrophomina phaseolina* (Tassi) Goid., than late sown crops. At 30–90 days after sowing (DAS), stem rot incidence was highest (29.03–56.55) in case of sowing of extra early crop. At 90 DAS, it was followed sequentially by crops sown during mid-March (28.98), first April (22.48), mid-April (22.48) and end April (12.88). Stem rot disease showed declining trend in later sown crop. Very late sown crop attracted lowest disease of 0.84%. In all the sowing dates, the stem rot was initially low at 30 DAS but with time it progressed slowly in late crop but rapidly in early crops to a higher peak at 90 DAS. Shifting the date of sowing just by a fortnight from first of April to middle to end of April significantly changed the disease scenario. Highest fibre yield of 34.54 q/ha was observed in first April sown crop and it was followed by mid-April sown (33.9 q/ha) and mid-March sown (32.86 q/ha) jute.

Key words: *Corchorus olitorius*, *Macrophomina phaseolina*, stem rot, date of sowing

INTRODUCTION

Jute is one of the most important commercial crops of eastern India with an area of 0.91 million hectares and production of 11.82 million bales (one bale = 180 kgs) dry fibres with fibre productivity of 2349 kg per hectare. It is grown mainly in the states of West Bengal, Bihar, Assam, Andhra Pradesh, Orissa, Meghalaya with an area of 0.62, 0.14, 0.07, 0.02, 0.02 and 0.02 million hectares and production of 9.40, 1.28, 0.74, 0.19, 0.11 and 0.05 million bales dry fibres respectively. The percentage contributions to National production jute fibres of above mentioned states are 79.54, 10.80, 6.22, 1.62, 0.95 and 0.45, respectively (Anonymous, 2012). There is a hue and cry that jute is a dying crop and its area is shrinking every year all over India. But,

inspite of stiff competition from synthetic fibres, lush green jute crop is still prominently visible during April to July on the road side fields of almost all districts all over state of West Bengal beginning from north, namely, Coochbehar, Jalpaiguri, North and South Dinajpur, Malda to Murshidabad, Burdwan (mainly Katwa and Kalna region), Nadia, Hooghly, North 24 Parganas in the south. The typical smell of jute retting is felt till today during August to October showing extensive presence of this 'golden fibre' crop in these districts.

Stem rot of jute caused by *Macrophomina phaseolina* (Tassi) Goid. is economically the most important disease of jute affecting both yield and quality of fibre in both cultivated species, namely, *Corchorus olitorius* L. and *C. capsularis* L. Seed yield also declines both quantitatively and qualitatively due to this disease. Ten to twenty per cent

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yield loss has been estimated in different jute growing regions of India. Stem rot is the common name but the pathogen attacks any part of the plant at any stage of growth right from germination to harvest producing symptoms, like, damping-off, seedling blight, leaf blight, stem rot, collar rot and root rot. The disease is prevalent in both species in all the jute growing areas not only in India but also in all other countries where jute is grown.

The disease is seed, soil as well as air borne and continues to damage the crop starting from germination to maturity in both seed and fibre crops. Hence, management of the disease involves manipulation of soil condition, seed treatment and foliar application of fungicides or judicious combination of all. But so far, no resistant/ tolerant variety is available in jute in either of the two species at least at the cultivators' level (Mandal *et al.* 2000; Mahapatra *et al.* 1994; Kar *et al.* 2009). Environmental and soil factors, namely, soil moisture, relative humidity and air temperature are involved in development of stem rot of jute. Jute crop in acid soils with pH 6.0 and below is more readily attacked than a crop at neutral soil (Roy *et al.*, 2008).

Tossa jute being most widely cultivated in all the jute growing areas, this investigation has been undertaken to determine the effect of early and late sowing of jute variety JRO 8432 on stem rot disease caused by *M. phaseolina* in the field.

MATERIALS AND METHODS

The experiment was conducted for two years (2010 and 2011) in randomized block design in the field of main research farm of CRIJAF, Nilganj, Barrackpore, India during normal cropping season with variety, JRO 8432. The soil of the experimental plot was sandy loam and neutral in nature (pH 6.5 - 7.5). The inoculum density of *M. phaseolina* was 2.6×10^2 colony forming units at the surface up to 5 cm depth, gradually decreasing with the depth. Standard agronomic practices were followed except advancing and delaying sowing dates as required for different treatments. The treatment comprised of sowing on 7/8 different dates at 15 days interval beginning 15 March and continued late up to 15 June during 2010 and 2011. They were termed as very early, early, normal I, normal II, late, very late and extra very late sowing. Per-

centage incidence of stem rot was noted at fortnightly intervals starting from 30 days after sowing (DAS) after final thinning of crop. No plant protection chemical was applied.

RESULTS AND DISCUSSION

Effect of sowing dates on incidence of stem rot of jute

During first year : Early sown crops suffered most severely from stem rot. Very early sown crop showed highest incidence of 29.8 % stem rot at 90 DAS, followed sequentially by early, normal I, normal II, late and very late sown crop, respectively, with 21, 16.3, 13.1, 12.9, 11.8. Crop sown on 15.6.2010 showed least amount of stem rot (7.3 %) at 90 DAS.

Early sowing of jute on 1.4.2010 showed maximum of 2.5 % of stem rot at 30 DAS followed by normal and late sown crop. Lowest percentage incidence (1 %) was recorded after one month in extra very late sown crop. At 45 DAS, again early sown crops invited more stem rot than later sown crops. March – April sown crop showed around 5 % stem rot incidence compared to 2 % in timely sown crops, whereas, the disease further reduced to 1 or even less than one in crops sown during May – June. At 60 DAS, the incidence of 13.5 % stem rot in March sown crop drastically reduced to 4 - 7 % in crops sown during normal time. At this age, extra very late crop sown on 15.6.2010 suffered least (1.8 %) from stem rot. At 75 DAS, maximum incidence (24.8 %) of stem rot was observed in very early crop sown on 15.3.2010 and it slowly reduced in the crops sown later reaching minimum of 5.5 % at extra very late sowing on middle of June. In crop sown timely during April, 6, 13 % stem rot was recorded (Table 1, Fig. 1, 2 and 3).

During second year : Early sown crop suffered from more stem rot. Highest stem rot (56.5 %) was observed in jute sown on first March while lowest (1.8 %) was in mid-June sown crop. The incidence of stem rot decreased slowly with delaying of sowing of jute. As sowing was done in the middle of March, 42.7 % stem rot was observed and in the jute sown on first of April, stem rot was further reduced to 34.5%. Only 22.2 % stem rot was observed in mid-April sown jute. Further shifting the

Table 1: Effect of different dates of sowing on the incidence of stem rot on jute variety JRO 8432 in the field during 2010

SN	Treatments	Date of sowing	% stem rot infected plant at different DAS*					Fibre yield (q/ha)
			30	45	60	75	90	
T1	Very early sowing	15.3.2010	1.41	5.38	13.55	24.85	29.83	28.45
			(6.79)	(13.38)	(21.17)	(29.89)	(33.09)	
T2	Early sowing	01.4.2010	2.53	5.39	7.45	13.57	21.07	29.13
			(5.39)	(12.89)	(15.29)	(21.56)	(27.31)	
T3	Normal sowing I	15.4.2010	1.60	2.63	7.55	13.34	16.34	28.55
			(6.85)	(8.54)	(15.11)	(21.41)	(23.80)	
T4	Normal sowing II	30.4.2010	1.60	2.56	4.92	6.65	13.16	25.94
			(7.21)	(9.16)	(12.74)	(14.93)	(21.22)	
T5	Late sowing	15.5.2010	1.59	2.10	7.24	9.59	12.93	27.80
			(7.18)	(8.24)	(15.60)	(17.99)	(21.03)	
T6	Very late sowing	30.5.2010	1.05	1.70	8.72	9.17	11.87	25.34
			(5.63)	(7.41)	(17.13)	(17.61)	(19.78)	
T7	Extra very late sowing	15.6.2010	1.02	0.98	1.86	5.52	7.33	12.61
			(5.44)	(5.66)	(7.75)	(13.59)	(15.63)	
	CD (P=0.05)		(3.68)	(3.97)	(5.50)	(2.13)	(3.93)	4.95
	SEm±		(1.75)	(1.89)	(2.61)	(1.01)	(1.87)	2.36

* Figures in the parentheses indicate Arc Sine transformed values.

sowing dates to later in the season, the stem rot slowly declined steadily to 19.2 % in first of May sown jute and 15.4 % in middle of May sown jute.

to 2.2 % at 30 DAS. This reduction in the stem rot incidence had significant impact in jute cultivation, as the disease may be checked to some extent by

Table 2 : Effect of different dates of sowing on the incidence of stem rot of jute variety JRO 8432 during 2011.

SN	TREATMENTS/ DATE OF SOWING	% incidence of stem rot caused by <i>Macrophominaphaseolina</i> *					Fibre yield (q/ha)
		30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	
T1	01.03.2011	29.03 (32.57)	38.62 (38.41)	45.25 (42.26)	47.60 (43.62)	56.55 (48.90)	26.61
T2	15.03.2011	5.07 (12.85)	12.17 (20.50)	12.77 (20.50)	30.95 (33.74)	42.73 (40.78)	
T3	01.04.2011	3.45 (10.50)	6.30 (18.76)	10.35 (18.76)	26.29 (30.80)	34.58 (35.86)	30.25
T4	15.04.2011	2.22 (8.51)	5.64 (28.07)	8.36 (16.81)	16.99 (24.32)	22.21 (28.07)	
T5	01.05.2011	2.04 (8.20)	5.37 (25.95)	7.68 (16.09)	15.14 (22.68)	19.20 (25.95)	27.86
T6	15.05.2011	2.41 (8.810)	3.16 (22.30)	6.58 (14.85)	8.72 (17.03)	15.42 (22.30)	
T7	31.05.2011	1.99 (8.02)	2.37 (10.54)	2.74 (9.50)	2.98 (9.91)	3.35 (10.54)	16.60
T8	15.06.2011	1.06 (5.82)	1.22 (7.70)	1.33 (6.54)	1.59 (7.18)	1.82 (7.70)	
	CD (P=0.05)	(3.20)	(6.65)	(3.89)	(4.78)	(8.37)	4.42
	SEm±	(1.52)	(3.16)	(1.85)	(2.27)	(3.98)	2.11

* Figures in the parenthesis indicate arc sin transformed values.

The incidence of stem rot decreased drastically to only 3.3 % in last day of May sown crop and finally to a lowest of 1.8 % in jute crop sown in middle of June, 2011.

Within the optimum time of sowing of jute, i.e., mid-March and mid-April sown crop, stem rot reduced slowly from 42.7% to 22.2 % at 90 DAS and 5.0 %

simply shifting the sowing dates by almost a fortnight and involving no application of harmful chemical (Table 2, Fig. 4, 5 and 6).

Crop age and stem rot of jute

During first year:The incidence of stem rot was more or less similar initially irrespective of the time

of sowing of jute. But the disease built up differently with time in crops sown at different time. The progress of stem rot was slower in late sown crop than timely sown jute. But stem rot spreads very

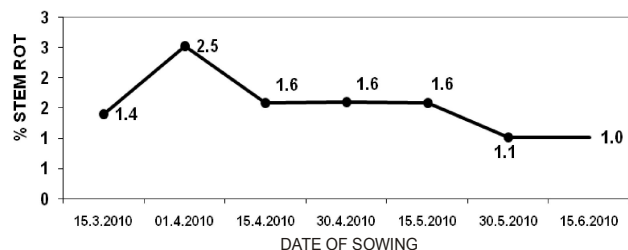


Fig. 1 : Jute stem rot at 30 DAS

fast in jute crop sown very early during middle of March. When stem rot in crops sown during normal time was compared it was observed that the

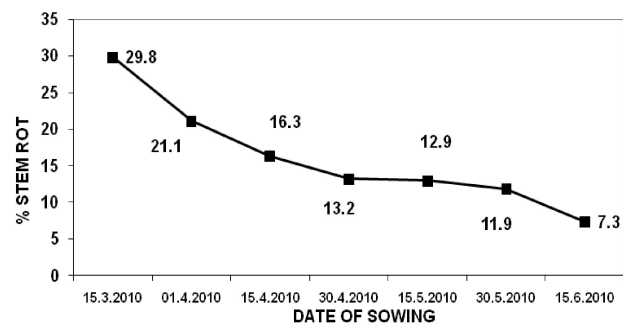


Fig. 2 : Jute stem rot at 90 DAS

disease progressed uniformly from low level (1.6 %) to a moderate level of 13.1 - 16.3 % at 90 DAS with increase in age of the crop. But in late sown

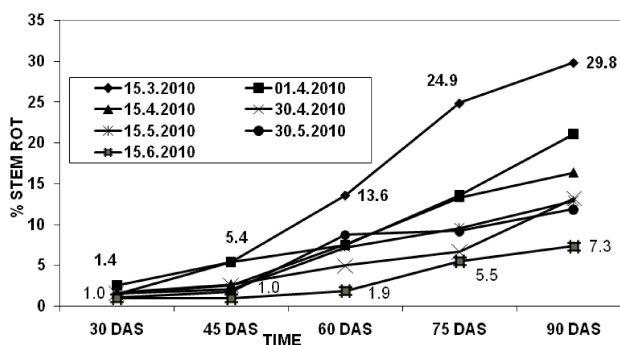


Fig. 3 : Effect of different dates of sowing on the progress of stem rot on jute variety JRO 8432 in the field during 2010

crop, the stem rot incidence was 1 % initially, it later increased to 7 - 8 % at 60 DAS and finally it reached to a peak of 11 -12 % at the maturity of the crop. In case of very early sown (in middle of March) crops, rapid progress of stem rot was noticed. At 30 DAS, incidence of stem rot was within

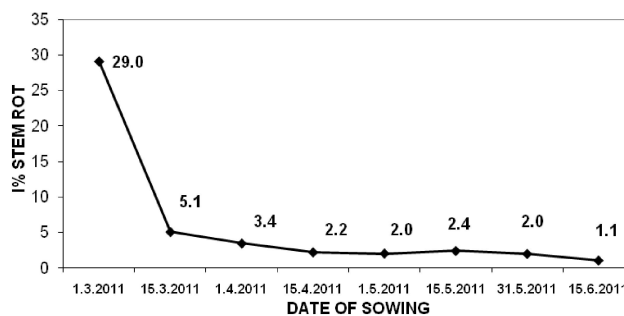


Fig. 4 : Effect of different dates of sowing on the incidence of stem rot of jute variety JRO 8432 at 30 DAS

a narrow range of 1 – 2 %, but with time it progressed very fast to 13.5 % at 60 DAS and then quickly to 29.8 % at 90 DAS reaching highest level

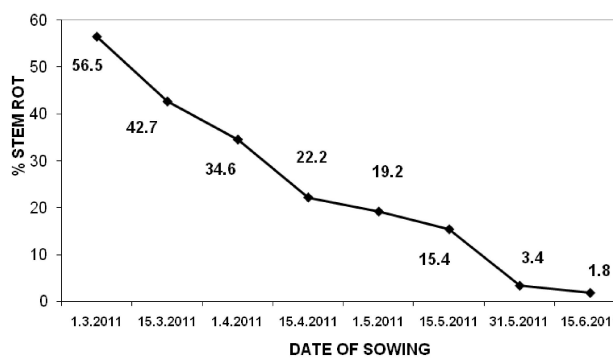


Fig. 5 : Effect of different dates of sowing on the incidence of stem rot of jute variety JRO 8432 at 90 DAS

of stem rot in case of very early crop sown on 15.3.2010. On the other hand, in the crops sown timely during first fortnight of April 2010, the inci-

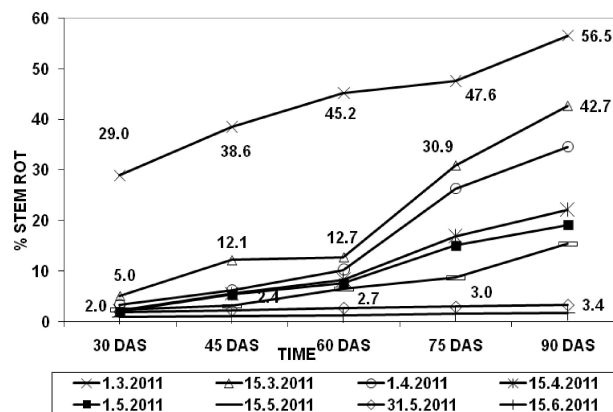


Fig. 6 : Effect of date of showing on progress of Jute Stem rot with time

den- ce of stem rot rose from initial almost equal level of 1 % to 13 – 16 % at the end of the crop before harvest (Table 1, Fig. 3).

During second year: In the jute sown on first

Table 3 : Effect of different dates of sowing on the incidence of stem rot of jute variety JRO 8432 during 2010 and 2011 (pooled mean data of both years).

SN	Treatments	Date of sowing	% stem rot infected plant at different DAS*					Fibre yield (q/ha)
			30	45	60	75	90	
			29.03	38.62	45.25	47.60	56.55	
T1	Extra early sowing	01.3.2011 15.3.2010	(32.57) 2.51	(38.41) 7.34	(42.26) 9.27	(43.62) 19.33	(48.90) 28.98	26.61
T2	Very early sowing	15.3.2011 01.4.2010	(8.99) 1.74	(15.72) 3.80	(17.67) 6.14	(26.05) 15.95	(32.53) 22.48	32.86
T3	Early sowing	01.4.2011 15.4.2010	(7.35) 1.17	(11.15) 3.38	(14.29) 4.87	(23.53) 9.71	(28.26) 12.88	34.54
T4	Normal sowing I	15.4.2011 30.4.2010	(6.17) 1.07	(10.58) 3.01	(12.75) 4.24	(18.13) 8.52	(21.00) 11.01	33.90
T5	Normal sowing II	30.4.2011 15.5.2010	(5.92) 0.85	(9.86) 0.92	(11.86) 2.21	(16.91) 2.77	(19.37) 4.04	31.22
T6	Late sowing	15.5.2011 30.5.2010	(4.72) 1.02	(5.33) 1.21	(8.16) 1.40	(9.40) 2.04	(11.58) 2.20	30.09
T7	Very late sowing Extra very late	30.5.2011 15.6.2010	(5.70) 0.49	(6.26) 0.57	(6.75) 0.62	(8.16) 0.74	(8.53) 0.84	25.19
T8	sowing	15.6.2011	(3.97)	(4.29)	(4.46)	(4.89)	(5.24)	15.84
	CD (P=0.05)	-	(3.09)	(2.35)	(3.09)	(3.41)	(5.00)	3.82
	SEm \pm	-	(1.47)	(1.12)	(1.47)	(1.63)	(2.38)	1.82

*Figures in the parentheses indicate Arc Sine transformed values

March, the stem rot increased rapidly from 29 % at 30 DAS to 38.6% in 45 DAS, 45.2 % in 60 DAS, 47.6 % in 75 DAS and finally to 56.5 % at 90 DAS. In case of jute crop sown in all other early dates, the stem rot sharply increased from 30 DAS to 45 DAS, 60 DAS, 75 DAS and 90 DAS.

The progress of stem rot was very slow in the late sown jute crop. In crops sown on 31.05.2011, the stem rot incidence progressed slowly from 1.9 % at 30 DAS to 3.3 % at 90 DAS. Stem rot incidence also increased slowly from 1 % at 30 DAS to 1.8 % at 90 DAS, when jute was sown on 15.06.2011. In the mid-March sown jute, stem rot increased quickly from initial 5 % at 30 DAS to 42.7 % at 90 DAS, whereas, mid-April sown crop the disease appeared with 2.2 % incidence at 30 DAS and later it reached a peak of 22.2 % at 90 DAS.

At 30 days age of the jute crop, higher incidence of stem rot was observed in crop sown earlier and it slowly reduced in later sown crops. In rest all other crop ages at 45, 60, 75, 90 days of the jute crop, higher stem rot incidence was observed in crop sown earlier than in later sown crops. Due to rapid inoculum build-up of stem rot, the progress of stem rot was evident in all the sowing dates from 30 to 90 DAS (Table 2, Fig. 4, 5 and 6).

Shifting sowing time and stem rot of jute

During first year: If the sowing time of jute was shifted from 15.3.2010 to 30.4.2010, the stem rot incidence was reduced from 29.8 to less than half to 13.1%. Stem rot showed a slow declining trend with shift of sowing time from 15.3.2010 with maximum of 29.8 % to 16.3 % in 15.4.2010 and further to a low level of 12.9 % in 15.5.2010 sown crops and finally to 7.3 % in case of mid-June sown jute. Shifting the date of sowing just by a fortnight from first of April to middle to end of April significantly changed the disease scenario. By postponing the sowing time by only 15 days as mentioned above reduced the stem rot incidence from 21 – 16.3 % without significantly affecting the fibre yield. Late sowing of jute may be suggested in areas where the stem rot occurs in problematic proportions and cause heavy damage to the crop (Table 1, Fig. 1 and 2).

During second year: If the sowing time of jute was shifted by a fortnight or so from first March to mid-March to further mid-April, i.e., 01.03.2011 to 15.03.2011 to 01.4.2011, the stem rot incidence was reduced from 56.5% to a lesser of 42.7 % to further down to 34.5%. Stem rot showed a slow declining trend with shift of sowing time from

01.03.2011 with maximum of 56.5 % to 22.2 % in 15.04.2011 and further to a low level of 15.4 and 3.3 % in 15.05.2011 and 31.05.2011 sown crops and finally to 1.8 % in case of mid-June sown jute. Shifting the date of sowing just by a fortnight from first of April to middle to end of April significantly changed the disease scenario. By postponing the sowing time by a fortnight as mentioned above reduced the stem rot incidence significantly (Table 2, Fig.4, 5 and 6).

Stem rot and fibre yield of jute

During first year: Crop sown early on 1.4.2010 gave highest fibre yield of 29.1 q/ha followed by very early crop sown on 15.3.2010 (28.4 q/ha) and crops sown on normal time on 15.4.2010 (28.5 q/ha). Surprisingly, they also suffered from stem rot most. There was no significant difference in fibre yield in crops sown during very early to timely sown to late crops, although the load of stem rot on these crops varied greatly. By adjusting the time of sowing by only 15 days reduced the stem rot incidence from 21 – 16.3% to further 12.9 % without significantly affecting the fibre yield. In other words, the timely sown had the ability to produce more yield in spite 13 – 16 % of disease incidence. However, the crops sown later in the season suffered less from stem rot and simultaneously yielded low fibre. Therefore, the time of sowing of jute was more important than incidence of stem rot. Crop sown later could not yield better despite less stem rot incidence (Table 1).

During second year: Highest fibre yield of 30.25 q/ha was observed in jute crop sown on 01.04.2011, it was followed by yield of crop sown on 15.04.2011 (29.72 q/ha), 01.05.2011 (27.86 q/ha), 15.03.2011 (27.79 q/ha) and 01.03.2011 (26.61 q/ha) with no significant difference among these treatments. In other words, jute crop sown at any date in between first of March to May gave similar fibre yield in spite of maximum load of stem rot disease (56.55 %) in the earlier sown crop. However, lowest fibre yield (14.88 q/ha) was recorded in crop sown latest on 15.06.2011, followed by jute sown on 15.05.2011 (16.60 q/ha). Low stem rot was noticed in crop with lower fibre yield. Yield levels in two later crops had no significant difference (Table 2).

Pooled mean of first and second year

At 30 -90 DAS, stem rot incidence was highest

(29.03 - 56.55%) in case of sowing of extra early crop. At 90 DAS, it was followed sequentially by crop where sowing was done during mid-March (28.98%), first April (22.48%), mid-April (12.88%) and end April (11.01%). Stem rot disease showed declining trend in later sown crop. Mid-May sown jute crop exhibited 4.04 % stem rot and 2.20 % was observed in May end sown jute crop. Extra very late sowing showed lowest disease of 0.84 %. In all the sowing dates, the stem rot was initially low at 30 DAS but with time it progressed slowly to a highest peak at 90 DAS.

Highest fibre yield of 34.54 q/ha was observed in first April sown crop and it was followed by mid-April sown (33.9 q/ha) and mid-March sown (32.86 q/ha) jute. Extra early sowing of jute gave fibre yield of 26.61 q/ha with high load of stem rot disease. Lowest fibre yield of 15.84 q/ha was observed in latest sown crop in mid-June. April end and mid-May sown jute yielded a fibre of 31.22 and 30.09 q/ha (Table 3).

With three dates of sowing of six varieties, namely, two *olitorius* (JRO 632 and JRO 878) and four *capsularis* (JRC 212, JRC 321, JRC 412 and D154), Mukherjee (1968) reported that stem rot was more in 22 March sown jute, lesser in 10 April and least in 1 May sown crop irrespective of species and varieties. He correlated the variation in stem rot with meteorological factors especially rainfall pattern. March sown crop is more prone to stem rot and root rot. Overcast cloudy condition, heavy rainfall resulting in near field capacity soil moisture, high atmospheric humidity, air temperature below 32°C and soil temperature below 30° C favoured infection (Rao, 1979; 1980). The rate of growth of four isolates of *M. phaseolina* in initial phase (5 days) was correlated with their virulence. The optimum temperature and pH were 34 ±1 °C and 6.8, respectively (Ghosh and Sen, 1973). De and Mandal,(2012a,b) reported four resistant lines of *olitorius* against stem rot in evaluation at hot spot of Sorbhog (Assam). Seed infection of jute (De and Mandal, 2012c), fungicidal management (De, 2012b) and inoculation technique (De and Mandal, 2008), influence of date of sowing (De, 2012a) were also reported. Out of eight isolates of *M. phaseolina* tested on 20 jute varieties (of both the species), six isolates showed different degrees of disease reactions while against the remaining two, all the varieties gave similar resistant reaction.

From the cultural characteristics, however, all the eight isolates differed from each other and were fitted in a dichotomous key as eight cultural races (Ahmed and Ahmed, 2005).

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