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In a field experiment, response of nitrogen, phosphate and potash fertilizer schedules was studied on the incidence of stem rot caused by *Macrophomina phaseolina* on a new jute variety JRO 8432 at CRIJAF, Barrackpore during 2012 - 13. Application of more nitrogenous fertilizer enhanced stem rot of jute. But increase in phosphatic and potassic fertilizers reduced stem rot. Among the different NPK fertilizer schedules, 120:30:30 attracted more stem rot of jute with 47.9 % disease at 120 DAS, followed by 120:40:40 with 40.5 %, 100:30:30 with 36.1 % and 80:40:40 with 35.2 % stem rot. With similar dosage of nitrogen, when phosphate and potash were increased, lower stem rot was recorded. Phosphate and potash fertilizer moderated the effect of deleterious effect of nitrogen by reducing the stem rot incidence. In check, stem rot increased from initial 0.3% to 2.2% in 45 days and finally to 21.6 % during the maturity of the crop. But in different NPK fertilizer treated plots, dynamics of stem rot was different showing varied interaction. The progress of disease over time was typically slowest in case of NPK 40:30:30. Higher level of nitrogen with phosphorus and potash not only increased susceptibility of jute plants and killed more plants due to high prevalence of stem rot disease but also increased dry fibre yield.

Key words: Jute, *Corchorus olitorius*, Stem rot disease, NPK fertilizer, *Macrophomina phaseolina*

INTRODUCTION

Jute *(Corchorus olitorius* L. and *C. capsularis* L.), better known as 'golden fibre' crop, is grown mostly in eastern region of India with an area of 0.91 million hectares and production of 11.82 million bales (one bale = 180 kgs) and dry fibres productivity of 2349 kg per hectare. It is cultivated as pre-*kharif* crop mainly in the states of West Bengal, Bihar and Assam with percentage contributions to National production jute fibres are 79.54, 10.80 and 6.22, respectively (Anonymous, 2012). Recently jute has emerged with stronger attributes due to its eco-friendliness with more oxygen producing, carbon dioxide absorbing and higher fuel wood producing capabilities, apart from its biodegradable diversified products.

Among biotic constraint of raw jute production, stem rot caused by *Macrophomina phaseolina* (Tassi) Goid. is economically the most important disease affecting both yield and quality of fibre in both cultivated species. Although 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 various symptoms, like, damping-off, seedling blight, leaf blight, stem rot, collar rot, root rot and spot on pod especially in seed crop. The disease is seed, soil as well as air borne and damages the crop in all jute growing areas in India and other countries starting from germination to maturity in both seed and fibre crops. For management of jute stem rot, manipulation of soil, pre-sowing seed treatment and foliar spraying of fungicides or judicious combination of all should be well considered (Roy *et al*. 2008).

Present investigation was undertaken to assess the influence on different nitrogen, phosphate and potassic fertilizer schedules on stem rot disease of jute in the field.

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MATERIALS AND METHODS

An experiment was carried out in the field with different dosages of nitrogen, phosphate and potash fertilizer on a new jute variety JRO 8432 with three replications in randomized block design to observe their effect on the incidence of stem rot caused by *M. phaseolina* at main farm of CRIJAF, Nilganj, Barrackpore, India during normal cropping season of 2012 - 13. The treatment comprised of seven different doses of N:P:K @ 40:30:30, 60:30:30, 80:30:30, 100:30:30, 120:40:40, 80:40:40, 120:40:40 kg per ha and check with no fertilizer. The 1/3 of nitrogen, full N phosphate and potash fertilizer were applied at basal during final land preparation and remaining 2/3 of nitrogen was given in two equal splits after first and second manual weeding, respectively, at 15 and 35 days after sowing (DAS). The soil in the experimental field was sandy loam and neutral in nature (pH 6.5 - 7.5). The inoculum density of *M. phaseolina* was 3.2×10^2 colony forming units at the surface up to 5 cm depth, gradually decreasing with the depth. Standard agronomic practices for commercial jute crop were followed except application of NPK as required for different treatments. No plant protection measure/ chemical was applied. Percentage incidence of stem rot was monitored at fortnightly intervals starting from 30 DAS after final thinning of crop.

RESULTS AND DISCUSSION

Effect of different dosages of nitrogen, phosphate and potash fertilizer on the incidence of stem rot of jute caused by M. phaseolina

During 2012, it was observed that application of high doses on nitrogenous fertilizer enhanced stem rot in JRO 8432 of jute. But with increase in doses of phosphatic and potassic fertilizer, the stem rot was reduced. Highest stem rot (49.4%) was observed in N: P: K @ 120:30:30 kg/ha, followed by 120:40:40 (42.6%), 100:30:30 (34.5%) and 80:30:30 (32.4%). Lowest stem rot (12.2%) was noticed in check plot where no fertilizer was applied. With increase in N from 40 to 120 kg/ha, stem rot increased slowly from 14.1 to 49.4%. But with increase in doses of phosphatic and potassic fertilizer, the stem rot was reduced. High P and K levels decreased the stem rot. With same nitrogen levels in N: P: K @ 120:30:30 and 120:40:40, higher P and K moderated the stem rot by reducing it from 49.4 to 42.6 per cent. Progress of stem rot over time was faster in N: P: K @ 120:30:30 than other treatments (Table 1).

During 2013, it was also observed that application of high nitrogenous fertilizer enhanced stem rot of jute. But with increase in doses of phosphatic and potassic fertilizer, the stem rot was reduced. Highest stem rot (46.5%) was observed in N: P: K @ 120:30:30 kg/ha, followed by 120:40:40 (41.7%), 80:40:40 (38.3%) and 100:30:30 (37.8%). Lowest stem rot (31%) was noticed in check plot where no fertilizer was applied. With increase in N from 40 to 120 kg/ha, stem rot increased slowly from 20.2 to 46.5%. But with increase in doses of phosphatic and potassic fertilizer, the stem rot was reduced. High P and K levels decreased the stem rot. With same nitrogen levels in N: P: K @ 120:30:30 and 120:40:40, higher P and K moderated the stem rot incidence.

In presence of greater dosage of nitrogenous fertilizer in N: P: K @ 120:30:30, jute stem rot increased rapidly from 0.4% at 15 DAS to 16.2% at 60 DAS and finally reaching peak of 46.5 % at 120 DAS. Progress of stem rot was also fast in other treatments with higher dosage of nitrogenous fertilizer. Slowest progress of stem rot was observed in check where no fertilizer was applied with only 5.8% at 60 DAS and 31% at final stage of the crop (Table 2).

Pooled effect of nitrogen, phosphate and potash fertilizer on stem rot of jutecaused by M. phaseolina Effect of NPK fertilizer on stem rot of jute

Among the different NPK fertilizer schedules, 120:30:30 attracted more stem rot of jute with 47.9% disease at 120 DAS, and it was followed by 120:40:40 with 40.5%, 100:30:30 with 36.1% and 80:40:40 with 35.2% stem rot. With similar dosage of nitrogen, when phosphate and potash were increased, lower stem rot was recorded. Phosphate and potash fertilizer moderated the effect of deleterious effect of nitrogen by reducing the stem rot incidence in the field. With equal level of phosphate and potash, exposure of high nitrogenous fertilizer enhanced susceptibility level of the jute plants to infection by *M. phaseolina* as was evidenced with 47.9% stem rot in NPK of 120:30:30 while 40.5% in 120:40:40. This reduction in incidence of stem rot from 47.9 to 40.5% was attrib-

Table 1 : Effect of different doses of nitrogen, phosphate and potash fertilizer on the incidence of Stem rot of Jute, variety JRO 8432 in the field during 2012

Treatments	% MEAN STEM ROT*							
N: P: K kg/ha	15 DAS	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	105 DAS	120 DAS
40:30:30	0.30 (3.07)	0.99 (5.62)	1.87 (7.80)	4.12 (11.56)	7.36 (15.49)	8.55 (16.99)	11.29 (19.63)	14.18 (22.11)
60:30:30	1.28 (6.39)	1.80 (7.57)	2.44 (8.97)	7.38 (15.31)	15.00 (21.98)	16.10 (23.47)	21. 23 (27.38)	23.17 (28.70)
80:30:30	0.54 (4.17)	1.52 (6.92)	2.60 (9.17)	2.31 (8.57)	11.80 (19.80)	20.38 (26.81)	29.26 (34.80)	32.47 (34.73)
100:30:30	0.76 (4.87)	1.21 (6.18)	2.94 (9.52)	9.80 (16.61)	16.95 (22.91)	24.00 (29.32)	32.64 (34.84)	34.55 (36.00)
120:30:30	1.01 (5.62)	1.60 (7.23)	3.25 (10.39)	9.66 (17.88)	19.03 (25.17)	30.06 (33.21)	42.62 (40.75)	49.41 (44.66)
80:40:40	0.88 (4.39)	1.34 (6.62)	2.94 (9.78)	6.26 (13.97)	12.88 (20.08)	17.61 (24.71)	25.83 (30.55)	28.63 (32.35)
120:40:40	0.54 (4.19)	1.35 (6.60)	2.49 (8.75)	7.37 (15.02)	14.89 (21.82)	23.81 (29.18)	41.36 (40.02)	42.64 (40.77)
CHECK	0.41 (2.91)	0.51 (3.90)	1.96 (7.80)	3.25 (9.93)	4.49 (11.78)	6.99 (15.31)	10.11 (18.52)	12.29 (20.51)
CD(P=0.05)	(3.25)	(2.40)	(3.73)	(8.27)	(2.69)	(3.91)	(2.25)	(2.41)
SEm$\pm$	(1.55)	(1.14)	(1.78)	(3.94)	(1.28)	(1.86)	(1.07)	(1.15)

*Figures in the parentheses represent angular conversion values.

Table 2 : Effect of different doses of nitrogen, phosphate and potash fertilizer on the incidence of Stem rot of Jute, variety JRO 8432 in the field during 2013

Treatments	% Mean Stem Rot*							
N: P: K kg/ha	15 DAS	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	105 DAS	120 DAS
40:30:30	0.10 (1.77)	1.01 (5.60)	2.59 (9.26)	4.57 (12.33)	9.64 (18.09)	12.63 (20.75)	16.60 (24.02)	20.29 (26.75)
60:30:30	0.54 (4.20)	0.92 (5.49)	3.62 (10.97)	5.82 (13.94)	15.83 (23.45)	22.01 (27.98)	25.39 (30.25)	28.84 (32.48)
80:30:30	0.38 (3.50)	1.59 (7.22)	4.69 (12.46)	8.98 (17.43)	18.17 (25.21)	25.29 (30.19)	28.65 (32.36)	34.65 (36.06)
100:30:30	0.58 (4.36)	2.72 (9.40)	6.50 (14.75)	11.65 (19.93)	17.63 (24.81)	28.22 (32.08)	33.23 (35.20)	37.81 (37.95)
120:30:30	0.49 (3.94)	3.23 (10.20)	9.49 (17.92)	16.27 (23.78)	26.78 (31.15)	35.50 (36.56)	40.62 (39.59)	46.58 (43.03)
80:40:40	0.47 (3.91)	3.89 (11.40)	8.68 (17.13)	15.05 (22.80)	24.21 (29.47)	33.03 (35.08)	35.29 (36.44)	38.39 (38.29)
120:40:40	1.06 (5.91)	3.84 (10.65)	10.41 (18.82)	14.69 (22.53)	22.20 (28.10)	30.54 (33.54)	38.79 (38.52)	41.76 (40.25)
CHECK	0.21 (2.60)	1.06 (5.84)	2.59 (9.26)	5.88 (14.03)	14.11 (22.06)	20.88 (27.17)	26.06 (30.69)	31.02 (33.84)
CD(P=0.05)	(0.98)	(3.81)	(1.29)	(1.67)	(1.82)	(2.04)	(1.52)	(1.98)
SEm$\pm$	(0.46)	(1.81)	(0.61)	(0.80)	(0.86)	(0.97)	(0.73)	(0.94)

*Figures in the parentheses represent angular conversion values

uted to the increasing tolerance of jute plants to stem rot infection in presence of high level of phosphate and potash in the soil.

In check with no fertilizer added, the stem rot of jute was lowest only with 21.6%. As the nitrogen level was slowly increased from a lower level of 40 kg/ha to comparatively higher level of 120 kg/ha, the susceptibility of jute plants to stem rot enhanced leading the incidence of more stem rot from 17.2 to gradually 47.9%. On the other hand, when the phosphate and potash level in the soil was increased from lower level of 120:30:30 to 120:40:40 kg/ha, incidence of stem rot of jute decreased from 47.9 to 40.5%. So, phosphate and potash fertilizer reduced the stem rot of jute and high nitrogen increased it (Table 3, Figure 1).

Table 3 : Pooled mean effect of different NPK fertilizer schedules on incidence of Stem rot of Jute, variety JRO 8432 in the field during 2012-13

Treatmens	% Mean Stem Rot*(pooled mean of two years)								Dry fibre yield (q/ha)
N: P: K kg/ha	15 DAS	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	105 DAS	120 DAS	
40:30:30	0.37 (3.41)	1.00 (5.73)	2.23 (8.59)	4.34 (11.98)	8.50 (16.90)	10.59 (18.98)	13.95 (21.91)	17.23 (24.52)	20.08
60:30:30	0.91 (5.44)	1.36 (6.65)	3.03 (10.02)	6.60 (14.70)	15.42 (23.12)	19.06 (25.85)	23.31 (28.85)	26.00 (30.64)	22.03
80:30:30	0.46 (3.85)	1.56 (7.13)	3.64 (10.94)	5.65 (13.74)	14.98 (22.77)	22.83 (28.54)	30.62 (33.60)	33.56 (35.40)	22.78
100:30:30	0.67 (4.68)	1.97 (8.05)	4.72 (12.46)	10.72 (18.78)	17.29 (24.56)	26.11 (30.72)	32.94 (35.02)	36.18 (36.98)	24.90
120:30:30	0.75 (4.95)	2.42 (8.94)	6.37 (14.61)	12.96 (21.05)	22.90 (28.59)	32.78 (34.92)	41.62 (40.18)	47.99 (43.85)	25.93
80:40:40	0.68 (4.44)	2.61 (9.30)	5.81 (13.94)	10.65 (19.03)	18.55 (25.51)	25.32 (30.20)	32.31 (34.64)	35.20 (36.39)	23.86
120:40:40	0.80 (5.13)	2.59 (9.25)	6.45 (14.68)	11.03 (19.26)	18.54 (25.49)	27.18 (31.41)	38.32 (38.25)	40.52 (39.53)	26.95
CHECK	0.31 (3.03)	0.79 (5.06)	2.28 (8.65)	4.56 (12.27)	9.30 (17.75)	13.93 (21.91)	18.09 (25.16)	21.66 (27.73)	14.83
CD (P=0.05)	(1.75)	(1.06)	(1.65)	(4.03)	(1.53)	(2.35)	(1.40)	(1.30)	1.32
SEm±	(0.83)	(0.51)	(0.79)	(1.92)	(0.73)	(1.12)	(0.67)	(0.62)	0.63

*Figures in the parentheses represent angular conversion values

Dynamics of stem rot of jute with different NPK fertilizer schedules

The incidence of stem rot of jute varied among all treatments including untreated check with a very narrow range of less than 1% initially at 15 DAS. When the progress of diseaseover time was considered, it was observed that in untreated check plot the stem rot increased from initial 0.3 to 2.2% in 45 days and finally to 21.6 % during the maturity of the crop. But in different NPK fertilizer treated

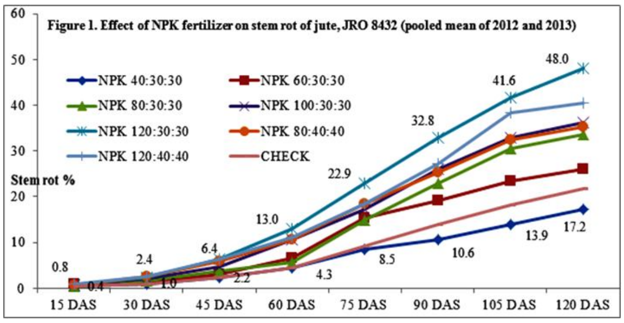

Fig. 1 : Effect of NPK fertilizer on stem rot of jute, JRO 8432 (pooled mean of 2012

plots, the progress of stem rot disease was different showing varied interaction of stem rot with N, P and K fetilizers. The progress of disease over time was typically slowest in case of NPK 40:30:30, where it rose from initial to 1% at 30 DAS to 4 – 8% at 60 - 75 DAS and finally to 17.2% at the harvest of the crop as the NPK dose was somewhat balanced. So, under NPK 40:30:30, stem rot of jute was not only progressed in snail's pace but also decreased the build-up of inoculum of disease over the crop growth period drastically. At the harvest of the crop, the variation in incidence of stem rot was great ranging from lowest of 17.2% at NPK 40:30:30 to a highest of 47.9% in NPK 120:30:30. The progress of stem rot of jute was fastest in NPK 120:30:30, with 0.7 to 6% at 45 DAS to 32.7% at 90 DAS and finally reaching a peak of 47.9% at 120 DAS (Table 3, Figure 1).

Different NPK fertilizer, stem rot of jute and dry fibre yield of jute

In spite of greater load of stem rot of 40.5%, highest dry fibre yield of 26.9 q/ha was obtained in case of NPK 120:40:40. Higher level of nitrogen with phosphorus and potash not only increased susceptibility of jute plants and killed more plants due to high prevalence of stem rot disease but also increased dry fibre yield. It was followed by 25.9 q/ha in NPK 120:30:30, 24.9 q/ha in NPK 100:30:30 and 23.8 q/ha in NPK 80:40:40 with stem rot disease load of 47.9, 36.1 and 35.2%, respectively. Lowest dry fibre yield of 14.8 q/ha was observed in case of check with no fertilizer added. With fertilizer schedules of NPK 40:30:30, 60:30:30 and 80:30:30, dry fibre yield of 20, 22 and 22.7 q/ha were recorded in spite of 17.2, 26 and 33.5 % stem rot incidences **(**Table 3, Figure 1).

Jute crop prefers neutral or near neutral soil reaction but in acid soils with pH 6.0 and below, it is more readily attacked by *M phaseolina*. With continuous cultivation of jute, soil is depleted of calcium, potassium and other base substances whereas, the presence of iron, manganese and aluminium increases due to development of acidity. But under acidic conditions with low availability of potash, the mere addition of lime only does not help to reduce disease, and a simultaneous application of potash is imperative. De (2014; 2015) reported the effect of nitrogen, phosphate and potash fertilizer on stem rot of jute caused by *M. phaseolina*. Depending upon pH level, application of lime or dolomite @ 2 – 4 t ha-^{1} at least 3 – 4 weeks before sowing once in 3 – 4 years is helpful in acidic soil. Therefore, selection of land plays a very important role for jute fibre productivity.

For good growth and yield, jute needs a substantial quantity of nitrogen, but application of N beyond 80 kg ha-^{1} and in new alluvial soils even above 60 kg ha-^{1} promotes incidence of stem rot, root rot and collar rot (Ghosh, 1983). Application of potash @ 50–100 kg K_2O ha^{-1} as basal dose can check the disease to a considerable extent (Cheng and Tu, 1970). These earlier findings supported present observations.

The severity of black spot disease caused by *Alternaria brassicae* was greater in soil with more NP and lower in K than unfertilized control in oilseed rape (Sharma and Kolte, 1994). NPK concentrations diminished african cassava mosaic disease with no effect on cercospora leaf spot disease of cassava (*Manihot esculenta* Crantz,) (Omorusi and Ayanru, 2011). Leaf rust (*Puccinia recondita*) and powdery mildew (*Erysiphe graminis*) infection in double crop soft red winter wheat (*Triticum aestivum*) showed a positive linear association with increasing N rate but phosphorus decreased the incidence of both (Donald and Johnson, 1987). P and K fertilization has a moderately suppressive effect on disease incidence but increased yield in agricultural crops. Plants with complete fertilizer (20-20-20) showed lowest incidence of *Phytophthora* root rot, mosaic virus and highest yield but with K had higher incidence of both in soybean (*Glycine max*) (Pacumbaba *et al*. 1997). Walters and Bingham (2007) reviewed effects of nitrogen, sulphur, phosphorus, potassium and silicon on disease development and potential for manipulating them to enhance disease control. Improving dry matter production and N, P, and K uptakes at the boot stage by P and K fertilization can reduce leaf rust severity later in the growing season and increase wheat grain yield (Sweeney *et al*. 2000).

It may be concluded that application of more nitrogenous fertilizer enhanced stem rot of jute. But increase in phosphatic and potassic fertilizers reduced stem rot. Hence, based on soil test results, judicious application of balanced NPK fertilizers combined with farm yard manure may be advocated for the management of jute stem rot, soil health and higher fibre yield of jute crop.

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