

Effectiveness of Streptocycline Spray Schedules on the Bacterial Blight Intensity and Yield of Clusterbean

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Abstract Thirteen schedules of streptocycline were attempted to record their effectiveness against bacterial blight [*Xanthomonas campestris* P.v. *cyamopsidis* (Patel *et al.*) Dye] of clusterbean [*Cyamopsis tetragonoloba* (L.) Taub.]. Seed treatment (250 ppm) followed by two sprays of streptocycline (100 ppm) at 5th and 7th week after planting significantly reduced the blight intensity and increased the grain yield. The combination provided an additional seed yield of 1.52 kg per rupee of additional investment on the antibiotic.

Key words Bacterial blight, Clusterbean, Streptocycline, *Cyamopsis tetragonoloba*, *Xanthomonas campestris* P.v. *cyamopsidis*

Bacterial blight caused by *Xanthomonas campestris* P.v. *cyamopsidis* (Patel *et al.*) Dye, is one of the most serious diseases of clusterbean [*Cyamopsis tetragonoloba* (L.) Taub.]. It is internally seed borne in nature (Srivastava & Rao 1963). To reduce seed borne infection, seed treatment with antibiotics is recommended (Sowell 1965, Lodha 1984). Under favourable environmental conditions, secondary spread of the disease causes considerable losses, which could be reduced by foliar sprays of streptomycin (Lodha & Gupta 1981, Gandhi & Chand 1985). Presently, information on the frequency, appropriate time and economic feasibility of foliar sprays is not available. Field experiments were, therefore, undertaken to identify critical stages for the foliar sprays, and to quantify effect of varying levels of blight indices on yield components and yield.

Materials and Methods.

The field experiments were conducted at the Central Arid Zone Research Institute, Jodhpur, during 1982 to 1984 crop seasons. Infected seeds of a susceptible clusterbean genotype 'FS 277' were treated with a 250 ppm solution of streptocycline for two hours. In 1982 and 1983, the experiment comprised of 14 treatments. After seed treatment, 13 spray schedules of streptocycline (Hindustan Antibiotics Ltd.) were given at 4,5,6,7,8,4-6,4-8,5-7, 5-9,6-8, 7-9, 4-6-8, 5-7-9 weeks after planting (WAP), and control (No seed treatment). In 1984,

only seven spray schedules (4, 4-6, 4-6-8, 5, 5-7, 7-9 and 5-7-9 WAP) were tested for their consistent efficiency alongwith control. Treatments were arranged in randomized block design with three replications. The concentration (100 ppm) of streptocycline was kept uniform for spray, however, the amount of the solution was increased with the crop growth. Bacterial suspension of *X. campestris* P.v. *cyamopsidis* in sterile water was uniformly sprayed in all the treatments by using an atomizer 8-10 days before cluster initiation.

Ten randomly selected plants were tagged from each replication of all the treatments. Disease intensity of these plants were recorded seven days after the last spray using 0-4 scale (Gandhi *et al.* 1978) and per cent disease index (PDI) was calculated. To study the effect of varying levels of blight components on yield, height, number of clusters and pods, and yields were recorded for all the tagged plants. Grain yield (kg ha^{-1}) was also recorded.

Correlation coefficients of the disease indices with yield and its components were worked out to establish disease severity yield loss relationship.

Results and Discussion

During crop seasons 1982 to 1984, appearance of bacterial blight was noticed from the seedling stage, but the severe manifestation was recorded only after the pod initiation stage. All the spray

Table 1 Effect of different streptocycline spray schedules on disease intensity, yield and its components of clusterbean in 1982 (a) and 1983 (b)

Time of spray (weeks)	Per cent disease index (PDI)		Plant height (cm)		Pods plant ⁻¹		Yield plant ⁻¹ (g)		Grain yield (kg ha ⁻¹)	
	a	b	a	b	a	b	a	b	a	b
4	39.2 (38.7)*	45.3 (42.3)	51	82	27	24	4.2	7.2	368	682
5	25.2 (30.1)	22.7 (31.7)	59	94	26	25	5.1	10.0	454	678
6	31.8 (34.3)	31.9 (34.4)	56	75	23	25	4.2	9.0	439	622
7	29.6 (32.7)	29.7 (33.0)	48	75	23	24	4.2	9.8	375	638
8	38.6 (38.4)	45.1 (42.2)	61	85	23	24	5.3	9.8	505	760
4,6	37.6 (37.7)	34.6 (35.6)	55	87	28	27	4.7	10.2	509	653
4,8	37.2 (37.5)	33.4 (35.2)	53	87	26	27	4.6	10.0	504	794
5,7	18.5 (25.3)	19.5 (26.2)	63	97	29	30	5.7	11.6	552	895
5,9	23.0 (28.6)	22.5 (28.2)	57	90	25	26	5.2	9.2	495	748
7,9	33.3 (35.1)	34.9 (36.1)	59	92	23	24	4.7	8.4	383	709
6,8	32.3 (34.6)	46.6 (43.0)	48	73	23	24	4.7	8.0	376	689
4,6,8	29.1 (33.6)	26.3 (30.8)	59	84	28	29	4.8	10.6	517	706
5,7,9	18.2 (25.2)	18.5 (25.4)	52	100	29	30	5.5	12.0	538	911
Control	63.1 (52.6)	65.4 (53.9)	45	69	18	20	3.5	6.1	337	519
CD 5%	3.5	3.5	9.4	12	4.5	4.7	1.1	2.5	80	201

* Angular transformed values

treatments were significantly superior over control in reducing bacterial blight incidence in all three years (Table 1 and 2). However, disease free situation was never obtained. Limited extent of check in secondary spread by 7 sprays of streptocycline against bacterial blight is reported in susceptible rice variety (Jain *et al.* 1966). In 1982 and 1983,

Table 2 Effect of different streptocycline spray schedules on disease intensity, yield and its components of clusterbean in 1984

Time of spray (week)	Percent disease index (PDI)	Plant height (cm)	Pods plant ⁻¹	Yield plant ⁻¹ (g)	Grain yield (kg ha ⁻¹)
4	36.8 (37.3)*	83	45	7.3	841
5	35.2 (36.2)	77	47	9.2	845
4,6	18.5 (25.3)	81	48	7.6	870
5,7	16.6 (24.0)	85	52	9.8	992
7,9	23.5 (28.9)	79	42	7.6	737
4,6,8	16.8 (24.2)	82	50	9.5	947
5,7,9	13.3 (21.3)	83	54	9.9	1023
Control	63.1 (52.6)	62	32	5.3	510
CD 5%	10.1	10.2	5.3	2.1	163

* Angular transformed values

among 'single spray' treatments, plants receiving spray at 5 WAP contracted least disease, while maximum grain yield was recorded in the spray treatment 8 WAP. The spray treatment 5 WAP was even significantly better than 'two spray' schedules of 4-6, 4-8, 6-8 and 7-9 WAP in reducing blight intensity. Significantly lower disease intensity was recorded in the schedule 5-7 WAP than in any other combination. In reducing blight incidence it was also superior than 'three sprays' given at 4-6-8 WAP. The treatment receiving 'three sprays' of streptocycline at 5-7-9 WAP had the lowest blight intensity among all the spray treatments in all the three years.

Seed treatment with streptocycline could delay the disease incidence for the first four weeks of planting. This was also evident by the fact that spray treatment 5 WAP contacted least disease indices among one spray treatments, while those carried out at 4,6,7 and 8 WAP were not found to be as effective. Perhaps, spray at 4 WAP was little early, while first spray after 5th week was late because by this time secondary infection had already set in.

Table 3 Economic returns from streptocycline spray schedules on clusterbean

Time of spray(week)	Average grain yield (kg ha ⁻¹) 1982, 83 and 84	Additional grain yield over control (kg ha ⁻¹)	Cost of streptocycline and labour (Rs ha ⁻¹)**	Additional grain yield per rupee investment on streptocycline treatment (kg Rs ⁻¹)
4	630.3	175.3	99.24	1.76
5	659.0	204.0	111.74	1.82
6	530.5*	75.5	111.74	0.68
7	506.5*	51.5	111.74	0.41
8	632.5*	177.5	124.24	1.30
4,6	677.3	222.0	136.74	1.05
4,8	649.0*	194.0	210.98	0.82
5,7	813.0	358.0	235.98	1.52
5,9	621.5*	166.5	235.98	0.64
7,9	609.6	154.6	273.48	0.57
6,8	532.5*	77.5	248.48	0.31
4,6,8	723.3	268.3	347.72	0.77
5,7,9	824.0	369.0	385.22	0.96
Control	455.0	—	—	—

* Average of two years (1982 and 1983)

** The cost of labour was taken to be Rs. 36.74 ha⁻¹ at the rate of Rs. 22.00 manday⁻¹ and the cost of streptocycline was Rs. 2.50 g⁻¹ at 1984 prices

Effect of blight severity on yield components and yield

Effect of varying levels of bacterial blight severity on yield components and yield of clusterbean was different in the years of low and normal rainfall. In 1982 (181 mm rainfall), plant height, pods plant⁻¹, plant and grain yield were significantly maximum in the spray schedule 5-7 WAP followed by the treatment receiving three sprays at 5-7-9 WAP. However, in 1983 and 1984 (305 and 221 mm rainfall, respectively), yield components and yield were maximum in the spray schedule 5-7-9 WAP followed by the schedule 5-7 WAP.

With an increase in blight intensity, indicated by disease index, there was a reduction in all the yield components. The reduction, which was gradual initially, became steep as the disease index increased beyond 50%. Plant height, number of pods plant⁻¹, plant and grain yield were negatively and significantly correlated with disease indices. The coefficients of correlation were -0.31 (height), -0.45 (pods), -0.29 (plant yield) and -0.43 (grain yield). There was some inconsistency in the reduction of clusters with the increase in blight intensity. This can be ascribed to the fact that severe manifestation of the disease began only after the initiation

of the clusters (Lodha & Gupta 1981). To quantify the relative contribution of each factor on grain yield, regression analysis was carried out by pooling the data of all the three years. The multiple regression equation so constructed is as under :

$$Y = 1.120 - .006 X_1 + .055 X_2 - 0.31 X_3 + .090 X_4 + .175 X_5 \quad (R^2 = .812)$$

Where Y, X₁, X₂, X₃, X₄ and X₅ are estimated values of grain yield, disease index, plant height, clusters, pods and plant yield respectively. Thus, almost 81.2% of variation in grain yield is explained by the various factors taken for the study.

Economics of streptocycline application

Among the 13 schedule of Streptocycline spray, one that carried out in 5-7 WAP turned out to be economically more beneficial compared to control and most of the other treatments (Table 3). In this treatment, the additional seed yield per rupee of additional investment on antibiotic was 1.52 kg. In terms of yield, the grain yield (813 kg ha⁻¹) under this treatment was higher by 78% over the control (428 kg ha⁻¹). Yields per rupee invested in 'one spray' treatment 4 or 5 WAP was better

compared to the spray schedule 5-7 WAP, but the total grain yields were less by 19 to 23% compared to that in the latter treatment.

The findings of the present study indicated that in addition to first spray at 5 WAP, second spray at 7 WAP, coinciding flowering and pod initiation stage, appeared as highly effective combination. The importance of pods in contributing towards yield would justify spraying the crop at pod initiation and grain filling stage.

Streptomycin sprays at 5-7-9 WAP would reduce disease indices more than two spray at 5-7 WAP only in 1983 and 1984. More number of rainy days and higher precipitation in both the years prolonged the vegetative growth and pod formation period. This situation favoured the development of blight even after 7th WAP. In clusterbean, 4th to 10th WAP is the critical period for vegetative growth, cluster initiation, pod formation and grain filling. In a year of sub-normal rainfall (e.g. 1982) crop matures in 80-85 days and sheds its leaves a fortnight before, as a drought evading mechanism. Thus spray after seventh week may not be of any significance. On the other hand, third spray at 9th WAP is effective in the years of normal rainfall, with evenly distributed rainy days (crop maturity 95-100 days). However, on the basis of cost structure, only two sprays at 5-7 WAP are economically more beneficial.

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