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SEED PRODUCTION OF VELVET BEANS, SUNNHEMP AND PILLIPESARA AS INFLUENCED BY PLANT DENSITY AND PHOSPHORUS APPLICATION

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ABSTRACT

Field experiments were conducted at Tamil Nadu Agricultural University, Coimbatore during NEM season of 1993-94 and SWM season of 1994 to find the optimum spacing and P level for seed production of three green manure crops, pillipesara, sunnhemp and velvet beans. Velvet beans produced the highest seed yield of 2.03 t/ha in the NEM season while sunnhemp produced a high yield of 1.13 t/ha in the SWM season. Pillipesara produced a maximum of 795 kg/ha in the NEM season. Seed production varied with season. Highest seed yield was obtained at 60 x 20 cm in all the three crops. Application of 50 kg P_2O_5/ha significantly increased the yield components and seed yield. High net returns and BC ratio were obtained in velvet beans grown in NEM season.

KEY WORDS : Pillipesara, Sunnhemp, velvet beans, seed production

Seed is the basic input in agriculture. Green manures are mostly raised for the production of biomass, which is normally incorporated at pre-flowering phase. Hence there should be enough buffer stock of seeds to meet the season to season production of green manures. The availability of adequate amount of good quality seed is the most severe agronomic constraint limiting green manure usage. Agrotechniques for increased productivity of good quality seeds of green manure crops are not available to the farmers. Moreover, effective stand establishment is necessary for maximising yeild of crops. Ability for leguminous plants to utilise applied phosphorus (P) is strong. Hence a study was conducted to determine the optimum spacing and P level for seed production of three green manure crops.

MATERIALS AND METHODS

During the North-east monsoon (NEM) of 1993-94 and South-west monsoon season (SWM) of 1994, field experiments were conducted at the Tamil Nadu Agricultural University, Coimbatore on three green manure crops *viz.*, velvet beans (*Stizolobium deeringianum* Piperet Tracy), sunnhemp (*Crotolaria juncea* L.) and pillipesara (*Phaseolus trilopus* L.) under irrigated conditions. Soil of the experimental field was clay loam with pH 7.5, E.C. 0.2 ds/m, 0.6% organic C, 236.4 kg available N/ha, 14.7 kg available P/ha and 616.5 kg available K/ha. The experiments were laid out in a split plot design with three levels of spacing (30x20 cm, 45x20 cm and 60x20 cm) as main plot treatments and three levels of P (0,25,50 kg P_2O_5/ha) as subplot treatments. The treatments were replicated thrice. A common dose of 10 kg N/ha was applied to all the plots. Plant population was maintained as per treatments. Irrigation was given at fortnightly intervals if there was no rain.

RESULTS AND DISCUSSION

Effect of spacing and phosphorus application

Comparing the three crops, velvet beans produced the highest seed yield followed by sunnhemp and pillipesara. (Table 1). Plant density is an important factor in realising increased seed yields. Reducing the plant population from 1.67 lakh plants/ha (30 x 20 cm) to 0.83 lakh plants/ha (60 x 20 cm) increased the seed yield appreciatly in all the three crops. In velvet beans, there was 22.7 per cent increase in seed yield at wider spacing (60 x 20 cm) over closer spacing (30 x 20 cm). In pillipesara and sunnhemp, the percent increase was 22.4 and 15.3 respectively. Thus, the highest seed yield was obtained at lower density (60 x 20 cm) followed by medium (45 x 20 cm) and higher densities (30 x 20 cm). The reason might be greater competition among the plants for resources at higher density leading to reduction in yield components. The different yield components like number of pods per plant, pod and seed weight per plant, pod length and number of seeds per pod were greater at wider spacing in all the three crops. Increased yeild components at wider spacing led to increased seed yield. The extent of branching is influenced by interplant competition and number of

Table 1. Seed yield (kg/ha) of the three green manure crops

Treatments	Pillipesara		Sunhemp		Velvet beans	
	SWM	NEM	SWM	NEM	SWM	NEM
Spacing						
S_1 (30x20 cm)	256	576	927	479	1304	1572
S_2 (45x20 cm)	297	677	1033	562	1409	1645
S_3 (60x20 cm)	361	743	1094	619	1659	2034
SEd	12.07	3.79	24.61	5.68	40.29	18.17
CD (0.05)	33.55	10.52	68.32	15.76	11.86	50.43
P level						
P_0 (0 kg P_2O_5/ha)	257	621	885	529	1376	1612
P_1 (25 kg P_2O_5)	309	670	1033	548	1455	1736
P_2 (50 kg P_2O_5)	348	795	1137	583	1540	1902
SEd	9.53	3.24	37.76	3.20	11.9	16.02
CD (0.05)	20.76	7.06	82.29	6.98	25.94	34.92

Interaction effect (NEM)

Spacing / P application	Pellipesara				Sunnhemp				Velvet beans			
	P_0	P_1	P_2	Mean	P_0	P_1	P_2	Mean	P_0	P_1	P_2	Mean
S_1	524	589	613	575	451	469	515	479	1459	1612	1646	1573
S_2	631	692	705	676	532	555	598	562	1513	1670	1751	1644
S_3	707	727	795	743	602	618	635	619	1866	1927	2308	2033
Mean	621	670	704		528	547	583		1612	1736	1902	
	Pat S	Sat P			Pat S	Sat P			Pat S	Sat P		
SEd	5.62	5.95			5.54	7.26			29.04	27.75		
CD	12.25	14.41			12.08	18.47			70.05	60.47		

S : Spacing levels
S_1 : 30 x 20 cm
S_2 : 45 x 20 cm
S_3 : 60 x 20 cm

P : Phosphorus levels
P_0 : 0 Kg P_2O_5/ha
P_1 : 25 kg P_2O_5/ha
P_2 : 50 kg P_2O_5/ha

branches is reduced at denser plant population. This may be another reason for reduced yield at high plant population. Reduced seed yield at high plant density have been reported in legumes by several authors (Akinola and Whiteman, 1975 ; Siddique *et al.*, 1984 ; Lawn and Troedson, 1990).

Application of P is essential for seed formation. Higher P application (50 kg P_2O_5/ha) produced more seed yeild than no P (control). The increase in yield in pillipesara, sunnhemp and velvet beans in SWM season at 50 kg P_2O_5/was 25.9, 22.14 and 10.5 per cent respectively over no P application (Table 1). Higher level of P augmented the plant to produce more number of pods as a consequence of high sink availability from increased dry matter production, which led to better growth of the reproductive parts. The result confirms the findings of Singh (1971). Applied P favoured the growth and yield components in an integrated manner which led to production of higher number of pods per plant, seeds per pod, pod and seed yield per plant and test weight of seeds (Table 2). Cumulative effect of all these factors ultimately increased the seed yield. The influence of P on seed yield of green manure crops is well documented (Singh, 1972 ; TNAU, 1981).

Interaction effect of spacing and P levels on seed yield

The combination of wider spacing (60 x 20 cm) and P application (50 kg P_2O_5/ha) produced significant increase in seed yield compared to individual effect of either of these inputs. Interaction effect on seed yield was significant for pillipesara during both seasons and for sunnhemp and velvet beans during NEM (Table 1). In the plant population x P study, reducing the plant population increased the seed yield of velvet beans by 22.7 per cent, application of 50 kg P_2O_5/ha raised the seed yield by 15.2 per cent but the use of lower plant density plus 50 kg P_2O_5/ha increased the seed yield by 37 per cent. Provision of more land area per plant and application of essential nutrient provided a more conducive environment for growth of plants.

Table 2. Yield components of pillipesara, Sunnhemp and velvet beans

Crop :	Pillipesara						Sunnhemp						Velvet beans					
Season :	SWM			NEM			SWM			NEM			SWM			NEM		
Yield compo-nents :	No.of pods/ plant	Pod wt/ plant (g)	No.of seeds/ pod	No.of pods/ plant	Pod wt/ plant (g)	No.of seeds/ pod	No.of pods/ plant	Pod wt/ plant (g)	No.of seeds/ pod	No.of pods/ plant	Pod wt/ plant (g)	No.of seeds/ pod	No.of pods/ plant	Pod wt/ plant (g)	No.of seeds/ pod	No.of pods/ plant	Pod wt/ plant (g)	No.of seeds/ pod
Treatments :																		
Spacing																		
S_1	23.4	5.7	11.1	35.9	11.9	10.5	52.3	10.5	11.6	25.3	11.2	9.6	35.3	379.5	5.4	52.6	555.2	5.4
S_2	28.2	6.6	11.3	41.0	13.6	11.3	59.0	11.8	12.4	30.4	12.6	10.5	42.7	445.3	5.4	59.1	637.1	5.4
S_3	32.8	7.6	11.7	46.7	15.3	11.6	62.8	12.6	13.2	34.7	14.2	11.6	49.8	50.25	5.8	69.0	728.8	5.7
SEd	0.58	0.11	0.11	0.45	0.25	0.06	0.71	0.14	0.11	0.30	0.15	0.07	0.31	3.92	0.02	0.75	7.48	0.08
CD	1.60	0.30	0.30	1.24	0.69	0.18	1.97	0.39	0.31	0.84	0.41	0.19	0.87	10.89	0.07	2.08	20.77	0.02
P_0	25.0	6.0	10.6	37.5	12.2	10.7	53.8	10.7	11.5	26.0	11.9	9.7	38.2	412.4	5.4	55.7	611.0	5.5
P_1	27.8	6.6	11.6	41.3	13.8	11.2	57.5	11.5	12.5	29.9	12.8	10.5	42.4	439.2	5.5	60.5	639.3	5.5
P_2	31.7	7.3	11.9	44.8	14.9	11.6	62.7	12.6	13.1	34.3	13.3	11.6	47.2	475.8	5.6	64.5	670.9	5.7
SEd	0.48	0.10	0.11	0.24	0.25	0.07	0.52	0.10	0.11	0.40	0.29	0.07	0.58	5.68	0.04	0.67	4.04	0.07
CD	1.04	0.22	0.23	0.52	0.54	0.15	1.13	0.23	0.24	0.88	0.65	0.16	1.27	12.37	0.08	1.45	8.80	0.16

Influence of season

Seed production is highly influenced by environmental conditions. Hence to exploit the full potential it should be sown in the right season.

Sunnhemp produced the highest seed yield in SWM season (1.13t/ha) while pillipesara (705 kg/ha) and velvet beans (2.036 t/ha) produced more yield in NEM season. During SWM season due to photoperiod sensitive nature of crop, velvet beans had a longer duration and produced more biomass. So partitioning of dry matter into reproductive parts was much less. Moreover high rainfall received after flowering and during pod development phase and high humidity led to rotting of pods by fungal incidence and thus seed yield was reduced. High rainfall in SWM season caused waterlogging and initial growth of sunnhemp was affected and this ultimately reduced the seed yield.

Economics of seed production

Velvet beans recorded higher net returns and BC ration than the other two crops in both the seasons (Table 3). This was followed by sunnhemp during SWM season and by pillipesara during NEM season. Raising pillipesara in SWM season and sunnhemp in NEM season was not economically viable. The net returns and BC ratio were higher in wider spacing due to reduction in seed cost and increased yield at wider spacing.

Table 3. Economics of Seed Production

Treatments	Pillipesara				Sunhemp				Velvet beans			
	Net Returns (Rs/ha)		B:C Ratio		Net Returns (Rs/ha)		B:C Ratio		Net Returns (Rs/ha)		B:C Ratio	
	SWM	NEM	SWM	NEM	SWM	NEM	SWM	NEM	SWM	NEM	SWM	NEM
S_1P_0	-1079	1129	0.65	1.37	3156	261	1.94	1.07	5520	7200	2.23	2.61
S_1P_1	-1645	1235	0.53	1.36	4026	152	2.07	1.04	5378	8010	2.10	2.64
S_1P_2	-1522	1046	0.60	1.27	3831	138	1.92	1.02	5765	7901	2.09	2.50
S_2P_0	-1175	2001	0.62	1.66	4174	989	2.27	1.30	6673	8145	2.68	3.05
S_2P_1	-1028	2076	0.70	1.60	4053	760	2.10	1.20	6955	8987	2.59	3.06
S_2P_2	-1034	1798	0.73	1.47	5570	722	2.37	1.18	7094	9254	2.49	2.94
S_3P_0	-708	2628	0.77	1.86	3797	1589	2.18	1.50	8723	11235	3.36	4.04
S_3P_1	-304	2376	0.91	1.69	5648	1304	2.55	1.36	9238	11310	3.25	3.75
S_3P_2	-622	2538	0.83	1.67	5658	1058	2.41	1.26	9585	13977	3.14	4.11

S_1 : 30 x 20 cm spacing
S_2 : 45 x 20 cm
S_3 : 60 x 20 cm

P_0 : No Phosphorus
P_1 : 25 kg. P_2O_5/ha.
P_2 : 50 kg. P_2O_5/ha.

Application of P enhanced the net returns in velvet beans in both the seasons (Table 3).

Thus, it can be concluded that for maximum seed yield the recommended spacing is 60 x 20 cm. Application of 50 kg P_2O_5/ha significantly increased the yield components and seed yield of all the three crops. Seed production varied with season and in economic terms the best green manure crop was velvet beans among the three tested. Due to its profuse pod bearing habit, high biomass accumulation and other multiple uses its inclusion in the cropping system is highly beneficial.

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EFFECT OF ORGANIC AND INORGANIC AMENDMENTS ON BHENDI IN LIGNITE MINE SPOIL

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ABSTRACT

Reclamation of mine spoil with various types of amendments like coir pith, gypsum, farm yard manure and pressmud and the effect on the performance of bhendi *Abelmoschus esculentus* (L.) Moench) was studied in Neyveli lignite mine spoil. The results indicated that incorporation of 12.5 t/ha each of coir pith and gypsum along with 25 t/ha each of farm yard manure and pressmud resulted in signiticant increase in the yield of bhendi. A minimum of 12.5 t/ha each of coir pith, gypsum, farm yard manure and pressmud are recommended for any reclamation and revegetation programme.

KEY WORDS : Lignite mine spoil, reclamation, amendments, bhendi

In India, about 27,346 ha of mine spoil are available due to 4082 mines (Dadhwal *et al.*, 1988). These are not suitable for cultivation (revegetation) without any amendments due to poor nutrient status, poor texture, structure and absence of adequate density of microflora. The lignite mine spoil at Neyveli is characterised to have massive structure, high bulk density, lower levels of organic carbon, available N and P and requires improvement in physical properties like structure, texture and bulk density (Varadharajan, 1994). Reclamation of lignite mine spoil with various types of amendments like coir pith, gypsum, farmyard manure and pressmud have been recommended by several workers. However, the combination of amendments and their quantities depend largely on the type and nature of spoil. Further, such reclamation work would be economically viable with those species which are relatively tolerant. Bhendi (*Abelmoschus esculentus* (L.) Moench) has been reported to be tolerant to mine spoil (Senthilkumar, 1995). Hence, an attempt was made to find out the optimum combination of amendments and their effect on bhendi.

MATERIALS AND METHODS

The experiment was conducted in the Department of Horticulture, Annamalai University