

The Effect of Single Superphosphate Levels and Plant Population on the Seed Yield Components of *Macroptilium atropurpureum* cv. Siratro

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ABSTRACT

The effect of varying levels of single superphosphate (SSP), as a source of phosphorus, and plant population on seed yield components of field grown Siratro was examined at Namulonge, Uganda. SSP at rates of 0, 100, 200, 300 and 400 kg ha⁻¹ was incorporated into the soil before Siratro seed was planted at a 30 cm within row spacing and at drill widths of 30, 60, 90 and 120 cm. There were no significant correlations between seed yield components and SSP levels. Total seed yield at the 30 cm row spacing was less than that of any of the three wider row spacings. There was also no significant interaction between plant population and SSP levels for seed yield components. Possible reasons for this lack of response are discussed.

Additional index words: fertiliser, plant density, pods per seedhead, seeds per pod.

INTRODUCTION

In Uganda Siratro (*Macroptilium atropurpureum* (DC.) Urb.) seed production is limited because of the difficulty of obtaining consistent economic seed yields. Although this may well be attributed to the climatic problems of an equatorial site for production (Hopkinson and Reid, 1979; Hampton, 1990) knowledge of agronomic practices such as plant population and the amount of phosphatic fertiliser required for optimum seed yield under the conditions prevailing in Uganda is lacking (Lusembo and Sabiiti, 1992). Plant population and soil nutrient levels are some of the most important factors that influence the reproductive growth of forage plants. The number of plants per unit area determines the degree of competition for environmental growth factors (Humphreys and Riveros, 1986).

Soils in Uganda are generally low in phosphorus (Zake, 1986) and more than any other element, phosphorus (P) limits the production potential of tropical legumes (Haque, Nnandi and Mohamed-Saleem, 1986; Skerman, Cameron and Riveros, 1988). In Siratro, pod density as well as seeds per pod are positively associated with a good supply of P (Velayudham, Kanodia, Agrawal and Dwivedi, 1979). However, preliminary studies at Serere, Eastern Uganda, showed that 300 kg ha⁻¹ of single superphosphate

(SSP) applied as a source of P to Siratro and other forage legumes had no significant effect on seed yield (Bajunirwe-Butsya, 1973). The initial soil P level was not determined and this result could simply indicate that the crops were already adequately provided with P. Despite this contra-indication, it is recommended that 250 kg ha⁻¹ SSP be applied for adequate forage legume establishment in Uganda (Wendt, Stobbs, Tiley and Tucker, 1970). This P rate, combined with a 50 cm drill width, is commonly used by Siratro seed producers.

There was, therefore, a need to re-examine the cost effectiveness of various fertiliser rates and plant populations used in Siratro seed production in Uganda. This paper reports the results of a study aimed at achieving the above objective.

MATERIALS AND METHODS

The trial was conducted at Namulonge Research Station (0° 32' N 32° 35' E and 1150 m a.s.l.) on a ferrallitic sandy clay loam soil with a pH of 5.8 and organic matter content of 3.4%. P was 6 ppm using the Bray P1 Method (Isaac and Johnson, 1984). Rainfall at the site is bimodal with peaks in March-May and September-November (Table 1).

Table 1. Monthly rainfall data during the year (1988) of the experiment.

Month	J	F	M	A	M	J	J	A	S	O	N	D
Rainfall (mm)	59	33	122	87	27	48	76	74	236	96	29	50

Source: Namulonge Research Station, Agrometeorological Section.

The trial area, which had been under fallow for six years, was prepared into a fine seedbed. A split plot design was used with SSP rates as the four main plots and plant

population as the sub plots, which measured 4 m x 4 m. SSP levels were 0, 100, 200, 300 and 400 kg ha⁻¹. Plant population was based on interrow distances of 30, 60, 90

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and 120 cm. SSP was incorporated into the soil before clusters of three seeds were planted in the given rows at a 30 cm within-row spacing. The plots were kept free of weeds by hand hoeing. Foliar and floral pests were controlled by Ambush CY (permethrin 500 g l⁻¹) at a rate of 500 g a.i. ha⁻¹.

The number of pods/seedhead was determined by counting pods on 20 randomly selected mature inflorescences per plot. The same pods were used for an indication of the average number of seeds per pod. Mature dry pods were harvested by hand at weekly intervals for two seasons in a year. Pods were further dried under the sun and seed threshed by hand. Clean seed was bulked and seed yield (kg ha⁻¹) calculated.

RESULTS AND DISCUSSION

Seed yield components of Siratro were not associated with SSP levels despite the low soil P level (6 ppm) of the experimental site as classified by the Bray P1 Method

(Table 2). Zake (1986) contended that some of the concepts on soil P that apply to temperate conditions may not be appropriate for highly weathered soils in Uganda. It is possible that even though P levels were low, what was available in the soil could have been mobilised and used by the plants, thus making application of SSP at the given levels not necessary. The plants could also have been colonised by indigenous and effective vesicular-arbuscular mycorrhizal fungi (VAMF) in the soil which could have stimulated growth in an apparently P-deficient soil, by increasing P uptake (Crush, 1974). However, uptake of P through VAMF in Siratro was found to be positively associated with increasing levels of applied phosphorus (Medina, Sylvia and Kretschmer, 1988). Whether effective and indigenous VAMF for Siratro are present in Ugandan soils needs to be verified.

Table 2. Effect of SSP levels on seed yield components of Siratro.

Seed yield component	SSP level (kg ha ⁻¹ yr ⁻¹)					SEM
	0	100	200	300	400	
Pods seedhead ⁻¹	3.3	3.2	3.2	3.3	3.0	0.15
Seeds pod ⁻¹	12.2	11.8	11.7	11.6	11.8	0.12

It could be said that existing soil phosphorus of up to 6 ppm P in uncultivated and long fallow lands in Uganda may not be a major limiting factor to seed production of Siratro during the year of establishment. However, repeated applications of small amounts of P may be necessary over time to avoid excessive depletion of P from the soil (Haque *et al.*, 1986).

There was no significant correlation between row spacing and seed yield components (Table 3). However, there seemed to be a positive, but not significant, association between row spacing and seed yield (Table 4). As other yields components did not differ, any increase in seed yield could be attributed to greater seedhead densities, as the trailing growth habit of Siratro (Skerman *et al.*, 1988) ensures that provided water is not limiting, there is an ample

framework of branches for flower initiation as row spacing increases up to an optimum. Low plant density due to appropriate row spacing also provides a better light environment for the flowering shoots (Humphreys and Riveros, 1986). However, at an interrow spacing of 30 cm, the crop formed a very thick mat of vegetative material which was not conducive to a high seedhead density. Both very low and very high densities reduce seed yield (Humphreys and Riveros, 1986). However, the maximum spacing above which seed yields may decrease was not determined in this experiment. Reduced seeding rate as a result of wide spacing would enable larger areas to be sown with a limited amount of high quality seed. There was no significant interaction between plant population and SSP levels for seed yield (Table 4).

Table 3. Effect of interrow spacing on seed yield components of Siratro.

Seed yield component	Spacing (cm)				SEM
	30	60	90	120	
Pods seedhead ⁻¹	3.1	3.0	3.5	3.2	0.12
Seeds pod ⁻¹	11.5	11.7	12.0	12.1	0.16

Table 4. Effect of interrow spacing and SSP levels on the seed yield of Siratro (kg ha⁻¹ yr⁻¹).

SSP level (kg ha ⁻¹)	Interrow spacing				Mean
	30	60	90	120	
0	176	176	241	220	203
100	181	196	195	209	195
200	145	170	212	187	179
300	183	207	159	234	196
400	129	207	190	159	171
Mean	163	191	199	202	189

s.e. spacing means ± 15 NS

s.e. SSP means ± 11 NS

s.e. spacing x SSP means ± 25 NS

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REFERENCES

- Bajunirwe-Butsya, E. 1973. Pasture Agronomy. Annual Report Part II 1972/73. Serere Research Station. Department of Agriculture, Uganda.
- Crush, J.R. 1974. Plant growth responses to vesicular arbuscular mycorrhiza. 7. Growth and nodulation of some herbage legumes. *New Phytologist* 73(4): 743-752.
- Hampton, J.G. 1990. Genetic variability and climatic factors affecting herbage legume seed production: an introduction. *Journal of Applied Seed Production* 8: 45-51.
- Haque, I., Nnandi, L.A. and Mohamed-Saleem, M.A. 1986. Phosphorus management with special reference to forage legumes in sub-Saharan Africa. In: Potentials of forage legumes in farming systems of sub-Saharan Africa. (ed. I. Haque, S. Jutzi, and P.J.H. Neate). Proceedings of a workshop held at ILCA, 16-19 September, 1985. ILCA, Addis Ababa, Ethiopia.
- Hopkinson, J.M. and Reid, R. 1979. Significance of climate in tropical pasture legume seed production. In: Pasture Production in Acid Soils of the Tropics. (ed. P.A. Sanchez and L.E. Tergas). p. 343. CIAT, Cali, Colombia.
- Humphreys, L.R. and Riveros, F. 1986. Tropical pasture seed production, p. 203. FAO Plant Production and Protection Paper 8. FAO, Rome.
- Isaac, R.A. and Johnson, W.C. 1984. Soil extractable phosphorus (Bray P1). In: Methodology for analysis of soil, plant, feed, water and fertiliser samples, p. 63-64. University of Georgia, Athens.
- Lusembo, P. and Sabiiti, E.N. 1992. Technology development of pasture seed production for small scale farmers in Uganda. Paper presented at 2nd FAO Regional Working Group on Grazing (RWG) in East Africa. Workshop held at Makerere University 30 March - 3 April 1992, Kampala, Uganda.
- Medina, O.A., Sylvia, D.M. and Kretschmer, A.E. Jr. 1988. Response of Siratro to vesicular-arbuscular mycorrhizal fungi: 1. Selection of effective vesicular-arbuscular fungi in amended soil. *Journal of the Soil Science Society of America* 52: 416-419.
- Skerman, P.J., Cameron, D.G. and Riveros, F. 1988. Tropical Forage Legumes. Plant Production and Protection Series No. 2. FAO, Rome.
- Velayudham, K.C., Kanodia, K.C., Agrawal, R. and Dwived, G.K. 1979. Effect of phosphorus application on the morphology and germination of Siratro seeds. *Forage Research* 5: 183.
- Wendt, W.B., Stobbs, T.H., Tiley, G.E.D. and Tucker, G.G. 1970. Pasture Handbook. Entebbe, Ministry of Agriculture for Uganda.
- Zake, J.Y.K. 1986. Preliminary findings of the investigations of the causes of infertility (Lunnyu) in some Uganda soils. *Proceedings of the 8th AGM, Soil Science Society of East Africa*, 15-19 December 1986. p. 115-120. Kampala, Uganda.