Seed Production Aspects of *Macroptilium atropurpureum* cv. Siratro in Uganda

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ABSTRACT

The effect of support height on seed yield components and seed quality of *Macroptilium atropurpureum* cv. Siratro was determined. Plants were sown at a spacing of 1 m x 1 m in a complete randomised block design replicated four times and staked at 0, 1, 2 and 3 metres high. Support significantly increased the number of inflorescences per plant ($P<0.01$), flowers per inflorescence ($P<0.01$), pods per seed head ($P<0.01$), seeds per pod ($P<0.05$), weight of 100 seeds ($P<0.05$), and seed yield per square metre ($P<0.01$). The number of inflorescences per plant and seed yield (g m^{-2}) were highly correlated with support height, $r^2=0.98$ and 0.97, respectively. Staking significantly ($P<0.05$) improved the germination rate and percentage of the harvested seed.

***Additional index words:* forage legume, germination, seed quality, small holder, Uganda**

INTRODUCTION

Grazing trials conducted at Serere in Eastern Uganda and Kawanda in the lake crescent region have shown that *Macroptilium atropurpureum* (DC.) Urb. cv. Siratro associates well with most of the recommended grass species, and improves the overall feeding value of the pastures in much of Uganda (Henderlong, 1973; Otim, 1973; Ochodomuge, 1978). Farmers' limited adoption and utilisation of this species in the country, and especially around research institutes, has been attributed to lack of adequate seed supplies (Sabiiti, Anyi and Iputo, 1987). The seed production capacity of experimental plots is far below the farmers' demand; yet farmers have been discouraged from producing seed of Siratro due to the disappointingly low seed yields (Kabeere, 1992). Although small quantities of seed used to be imported into the country, the prices have been too costly for many small holder farmers in Uganda (Anon., 1988). Moreover, foreign exchange is becoming more scarce and not available for any more importation of pasture seed. It is important therefore, for research to generate appropriate technologies to enable farmers to increase yields, and thus produce the seed economically.

It has been reported in several other countries that provision of support systems to climbing forage legumes improves seed yields (Castilo and Siota, 1978; Ferguson, 1978; Akinola and Agishi, 1989). Low seed yields on farmers' plots in Uganda can be attributed to a typically tropical environment which does not favour high reproductive growth of many tropical forage legumes (Hopkinson and Reid, 1978; Hampton, 1990). However, lack of climatic adaptation for seed production of climbing forage legumes in a particular location may be partially compensated for by a support system (Ferguson, 1978).

In Uganda, field observations show that Siratro growing wild on shrubs, trees and fencelines flowers more profusely than when trailing on the ground. On the assumption that a relationship exists between flowering and seed production, seed yield of this species would be improved by provision of support. Additionally, height might be responsible for the observed flowering, and thus support height could be a significant factor. The purpose of this study, therefore, was to determine the effect and relationship between support height and seed yield components of Siratro. The effect of seed size (as a result of staking) on seed quality in terms of germination rate and germination percentage was also determined.

MATERIALS AND METHODS

The experiment was conducted at Namulonge Agricultural and Animal Production Research Institute (0°32'N and 32°35'E) at an altitude of 1150 m. The soils are ferralitic sandy-clay-loams which are naturally low in phosphorus (4 ppm P, Bray II) and with a pH (H_2O) of 5.4-6.0 (Zake, 1986). Average annual rainfall is 1100 mm (Anon., 1992) and distribution is bimodal with peaks in March - May and September - November. The land which had been under natural fallow for five years was prepared into a fine seedbed. Single superphosphate was incorporated into it at a rate equivalent to 50 kg ha^{-1} P_2O_5. Plots (3 m x 3 m) with a 1m wide path were planted to Siratro using clusters of 3 seeds per hole at a spacing of 1 m x 1 m. Plants were staked at 0, 1, 2 and 3 metres high. A maximum staking height of 3 m was considered a height that could be reached by human hands to pick ripe pods while using the locally available wooden tripod stands. The

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treatments were arranged in a complete randomised block design with four replications. Seedlings were thinned to one plant per hole one month after planting. Dry stakes of locally available bamboo (*Arundinacea palmis*) were fixed 30 cm from the plant as appropriate. The plants were trained onto the stakes during weeding by using sisal strings. The crop was kept free of weeds by manual weeding. Ambush CY (permethrin 500 g l^{-1}) at a rate of 500 g a.i.ha^{-1} was used to control insect pests that attack young leaves and flowers.

The parameters measured were number of inflorescences per plant, flowers per inflorescence, pods per seedhead, seeds per pod and weight (g) of 100 seeds. These parameters collectively constitute seed yield components. Total seed yield, rate and percentage of germination of the harvested seed were determined. After flowering, five plants were randomly selected from each staked plot. The inflorescences on each of the selected plants were counted at fortnightly intervals through the entire experimental duration. Five quadrats of 1 m x 1 m were randomly and permanently placed in unstaked plots. They represented individual plants on the assumption that each plant had to occupy one square metre according to the spacing used. Inflorescences were counted and tagged with cotton wool as a measure against recounting.

The number of flowers per inflorescence was counted twice on five randomly selected inflorescences on all plants. Intertwining in unstaked plots made it difficult to identify individual plants, and thus 80 inflorescences were chosen at random and flowers counted. The number of mature pods per seedhead was determined in the same way as number of flowers per inflorescence. Mature and dry pods were harvested by hand at weekly intervals and dried under the sun in gunny bags to avoid seed loss due to shattering. Seed was harvested for two cropping seasons. The number of seeds per pod was determined by counting seeds in twenty randomly picked pods per harvest. Seed at every harvest was bulked and weighed per plot. Total seed yield was expressed in g m^{-2}. The average weight of four random samples of 100 seeds was determined. In the second rainy season, blight, a disease attributed to *Rhizoctonia solanii* in Siratro (Lenne and Sonoda, 1985), attacked the crop. Its incidence was estimated by counting the number of blighted leaves and comparing them to the total number of leaves in a 1 m x 1 m quadrat placed in the most affected areas, as determined by visual observation.

A germination test was carried out on four lots of 100 seeds for each treatment. Each sample of seed was immersed in concentrated sulphuric acid for 15 minutes to break hardseededness. The seeds were then washed with tap water and germinated on moist filter paper placed in petri dishes at room temperature (ISTA, 1985). Seed was considered germinated when the plumule emerged. Seedling counts were made daily from the third to the seventh day. The germination percentage was taken on the seventh day by summing up the total number of seeds whose plumules had emerged. The germination rate was determined according to Maguire (1962):

$$\text{Rate of germination} = X_1/Y_1 + (X_2-X_1)/Y_2 + \ldots X_n-X_n-1)/Y_n$$

Where, X_n = percentage seedling emergence at n^{th} count and Y_n = number of counts from planting to n^{th} count.

The data for all seed yield components were analysed for treatment effects by analysis of variance. The relationships between support height, number of inflorescences per plant and seed yield per plant were determined by regression analysis.

RESULTS AND DISCUSSION

Unstaked plots gave a significantly ($P<0.05$) lower number of flowers per inflorescence, pods per seedhead, seeds per pod and the weight (g) of 100 seeds than staked plots. The above seed yield components did not vary at various staking heights (Table 1). However, there was a positive correlation ($r^2=0.98$) between staking height and the number of inflorescences per plant (Fig. 1a). As the above components are the major determinants of total seed yield, staking significantly ($P<0.01$) increased total seed yield through the appropriate effect on seed yield components.

There was a positive correlation between staking height and total seed yield (Fig. 1b). This was attributed

Table 1. The effect of staking height on seed yield parameters and *Rhizoctonia solanii* blight incidence in *Macroptilium atropurpureum* cv. Siratro at Namulonge.

	Staking height (m)				
Yield parameters	**0**	**1**	**2**	**3**	**SEM**
Flowers/inflorescence	6.1a	8.4b	8.2b	8.4b	±0.2
Pods/seedhead	2.8a	4.4b	4.4b	4.5b	±0.3
Seeds/pod	11.1a	12.9b	12.9b	13.1b	±0.6
100 seed weight (g)	1.1a	1.4b	1.4b	1.4b	±0.1
Germination percentage	81.0a	90.0b	92.0b	90.0b	±3.0
Germination rate	18.0a	20.0b	21.0b	21.0b	±0.6
Percentage of blighted leaves	66.0a	10.5b	9.0b	9.0b	±2.0

Means in the same row with different letters are significantly different at P<0.05.

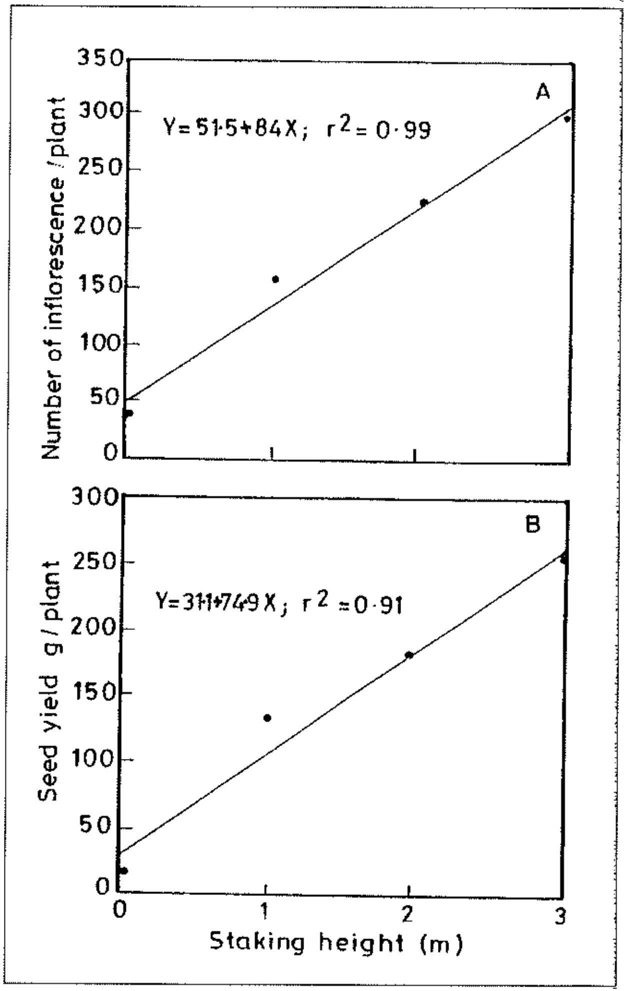

Fig. 1 The effect of staking height on number of inflorescences (A) and seed yield (B) per plant of *Macroptilium atropurpureum* cv Siratro grown at Namulonge.

to a larger support surface area as staking height increased (Akinola and Agishi, 1989). A casual observation showed that most flower formation and development, during the year of establishment, took place in the wet seasons. Those wet conditions should have been conducive to vegetative rather than reproductive growth (Humphreys and Riveros, 1986). It has been reported that mild moisture stress encourages flower initiation and development (Kowithayakorn and Humphreys, 1987). It could therefore, be assumed that the concept of mild moisture stress could increasingly be useful in flower initiation and seed formation as staking height increases. The above growth conditions did not seem favourable for flower initiation and seed development in the unstaked crop, hence the low yields. The disadvantage was negated by provision of stakes (Fig. 1b). There was a strong positive correlation (r^2= 0.93) between number of inflorescences per plant and seed yield (Fig. 2.). This would suggest that staking height influenced the number of inflorescences per plant, which in turn determined eventual seed yield. This point of view is strong, given that other seed yield components viz. flowers per inflorescence, pods per seedhead, seeds per pod and weight of 100 seeds were not strongly associated with staking height. However, the responses of all seed yield components indicate that they all require some form of support.

Intercepts of response were considerably higher than observed values for the number of inflorescences per plant and seed yield m^{-2} at zero height (Fig. 1). This implied that plants which were not staked failed to realise their potential. This failure was partly attributed to blight caused by soil-borne *R. solanii* (Lenne and Sonoda, 1985). Soil clinging on the roots of weeds may have increased the spread of blight in the unstaked plots during weeding in the rainy season. The incidence of blight was relatively low in staked plots. This may have come about as a result of the sheltering role of the crop canopy around the stakes which may have reduced the water drop size and terminal velocity of water reaching the soil surface. The reduced impact of raindrops on the soil could have reduced rain splash, and hence disease spread. That the incidence of the *R. solanii* may be considerably reduced if the plants are able to climb was also reported by Tarawali (1991).

A germination test indicated that staking in general significantly ($P<0.05$) increased the germination percentage and the rate of germination of the harvested seed (Table 1). However, there were no differences among the various staking heights for germination. The increase in the percentage and rate of germination of seed from staked plants over those from the sward plants was attributed to the relatively larger seed size obtained in the study (Reddy, Reddy, Rao, and Singh, 1989). Larger seeds may contain sufficient food reserves to facilitate fast and efficient germination. The unstaked crop produced smaller seeds, and this, coupled with the disease that affected the plants during the rainy season probably reduced the rate and percentage of germination.

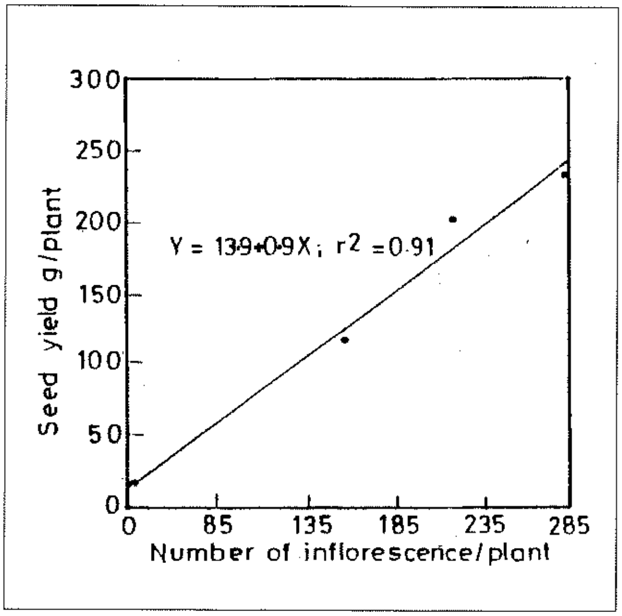

Fig. 2 The relationship between number of inflorescences and seed yield (g) per plant of *Macroptilium atropurpureum* cv Siratro.

CONCLUSION

It was concluded that staking increased seed yield of Siratro. The positive correlation between staking height and seed yield was a consequence of staking increasing the number of inflorescences per plant. Staking not only increased seed yield, but also seed quality, in terms of rate and percentage of germination.

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