

THE EFFECT OF SOME CULTURAL PRACTICES ON THE GROWTH AND YIELD OF THE MEDICINAL PLANT *SOLANUM VIRGINIANUM* SCHRAD. (KATUWELBATU)

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ABSTRACT

Experiments were conducted to study the effect of inorganic, organic and combined inorganic + organic fertilizer and natural shade under *Gliricidia* on the growth and dry matter (DM) yield of the medicinal plant *Solanum virginianum* Schrad. The yield of total dry matter and of different plant parts were also studied in plants harvested at 70, 90 and 110 days after establishment. Application of cow dung as organic fertilizer as the basal at a rate of 15,000 kg/ha plus a dose of inorganic fertilizer (12:9:8 N:P:K) at a rate of 200 kg/ha after one month gave the highest DM yields compared to organic fertilizer only at the rate of 25,000 kg/ha or inorganic fertilizer only at the rate of 400kg/ha both as basal. The type of the fertilizer package used also affected the composition of leaves, stems and berries in plants. DM yields were low in plants harvested at 70 days. Higher DM yields obtained from plants harvested at 90 and 110 days were mostly due to the presence of more berries. Shade always reduced the DM yield of plants and the reductions were 40.6% and 57.6% under 58.0% and 45.0% available light respectively.

Key words

dry matter, fertilizer, harvesting time, shade, *Solanum virginianum*

INTRODUCTION

Solanum virginianum (Katuwelbatu) is a common medicinal plant. It is an annual herb with a life span of about 4 months and is distributed throughout India and Pakistan. All parts of the plant are used in medicine. It is used as an expectorant, a treatment for cough, asthma, fever, heart diseases and many other conditions (Dastur 1952).

The annual requirement of this important medicinal plant in Sri Lanka is 135,094 kg and almost all of this is imported (Abeyawardana and Hettiarachchi 2001). The cultivation of this crop was not done in Sri Lanka until recently. Sometimes this plant is found growing in the dry zone farm lands, but systematic cultivation practices are unknown. High demand for the plant in traditional medicine and its new preparations has compelled to look into the possibilities of growing it but the available knowledge is limited. To start large scale cultivations, technology needs to be developed on aspects of fertilizer requirements, optimum light conditions, and

correct time of harvesting that ensure good yields of high quality products.

In commercial cultivations use of fertilizer becomes essential to obtain higher yields and optimum levels of light for growth also need to be determined; Sub optimal levels of both these factors limits plant growth (Squire 1993). Light stress reduces dry matter yields and also affects its distribution in plants (Hughes and Keatinge 1983). Addition of inorganic fertilizer is reported to have improved yields in *S. virginianum* (Pathiratna and Seneviratna 2000). It is also important to determine the correct harvesting time because the plants tend to shed leaves after initiation of flowering (Littleton *et.al.*1979), which can affect both the dry matter yield at harvest and the medicinal quality.

The data presented here are the results of some experiments performed to study the effects of fertilizer, shade and time of harvesting on growth, dry matter yield, and the composition of plant parts of *S. virginianum*.

MATERIALS AND METHODS

The effects of fertilizer, shade and time of harvesting on growth and yield were studied in separate experiments. In all these field experiments *S. virginianum* was planted at a spacing of 40 cm x 40 cm and the size of the planting holes were 30 cm³. The fertilizer used in these experiments except those performed to determine fertilizer requirements was cow dung at the rate of 25,000 kg/ha added as basal. The planting material used was 4- week old single seedlings in polybags.

Experiments on the effect of fertilizer

Organic fertilizer (cow dung) at the rate of 25,000 kg/ha as basal, inorganic fertilizer at the rate of 400 kg/ha as basal and a combination of organic fertilizer at the rate of 15,000 kg/ha as basal plus inorganic fertilizer at the rate of 200 kg/ha after one month were the three fertilizer treatments. The inorganic fertilizer was a commercial mixture comprising of 12:9:8, N:P:K. Randomized complete block design with three replicates was used in 8m² plots. The growth of the plants during the first 10 weeks was measured as plant diameter and was done conveniently because these plants grew prostrate on the ground. Harvesting was done 120 days after establishment. Fresh weight of plants from each plot was taken. Five random samples from each plot, weighing about 700g were taken, the parts were separated and dried at 70^o C for constant weight to determine dry matter yields.

Experiments on the effect of shade

The growth and the dry matter yield of plants under natural shade in the field provided by *Gliricidia* was studied in this experiment. *Gliricidia* was planted 2.0m x 2.0m in between the rows of *S. virginianum*. Control treatments received full sunlight and the treatments were allocated in 8m² plots in a randomized complete block experiment replicated three times. After harvesting the first, second cultivation was done in the same plots under similar conditions. Each cultivation was harvested 120 days after planting and the method used to determine the plant dry matter yields was similar to 2.1.

Measurements of available light (PAR) between the rows below the *Gliricidia* canopy was taken at 10.00, 12.00 and 15.00 hrs of the day using a Delta-T canopy analysis system. Twenty four such measurements for each treatment were

taken and was repeated for 2 consecutive days. These measurements were also repeated at the second cultivation.

Experiments on time of harvesting

In this experiment there were three harvesting treatments viz. 1) 70 days after planting (DAP) (first few berries started to appear), 2) 90 DAP (first few berries started maturing) and 3) 110 DAP (berries began to turn yellow). The treatments were allocated in 8m² plots replicated three times in a randomized complete block design experiment. The plants of the three treatments were harvested by uprooting at the respective stages of growth *i.e.* 70, 90 and 110 DAP. Plant parts were separated in the samples and the same method in 2.1. was followed to determine plat dry matter yields.

RESULTS

Effect of fertilizer on yield and the composition of plant parts

All modes of fertilizer treatment significantly increased the plant diameter up to the 4th week. Both treatments with the combined inorganic + organic and organic fertilizer maintained significant increases in growth during the whole period of study (10 weeks). But the height of plants was less in the organic fertilizer treatment than in the combined treatment. The significant increase in height shown in inorganic fertilizer treatment lasted only up to the 6th week (Fig 1).

The total dry matter yield per plant at harvest was 126.6g, 143.8g, 231.9g and 103.9g for inorganic, organic, organic + inorganic and control treatments respectively and the percentage increase of dry matter over the control was 21.8, 38.4 and 123.2 for inorganic, organic and organic +inorganic fertilizer treatments respectively. Differences in the yield of plant parts due to the effect of fertilizer were also evident in these results. The dry weights of leaves, stems and berries were significantly higher in the organic + inorganic fertilizer treatment than in all others. The organic fertilizer treatment also had significantly higher dry weight of leaves and stems compared to the inorganic or control treatments. But the dry weight of berries in this treatment was significantly lower than those in the

other two fertilizer treatments. (Fig.2)

Effect of shade under *Gliricidia*

S. virginianum was cultivated twice in the same plots. The light availability under the

canopy of *Gliricidia* was measured 45 days after the establishment of each cultivation and the percentage of incident PAR available was 58.0% and 45.0% at the 1st and 2nd cultivations respectively.

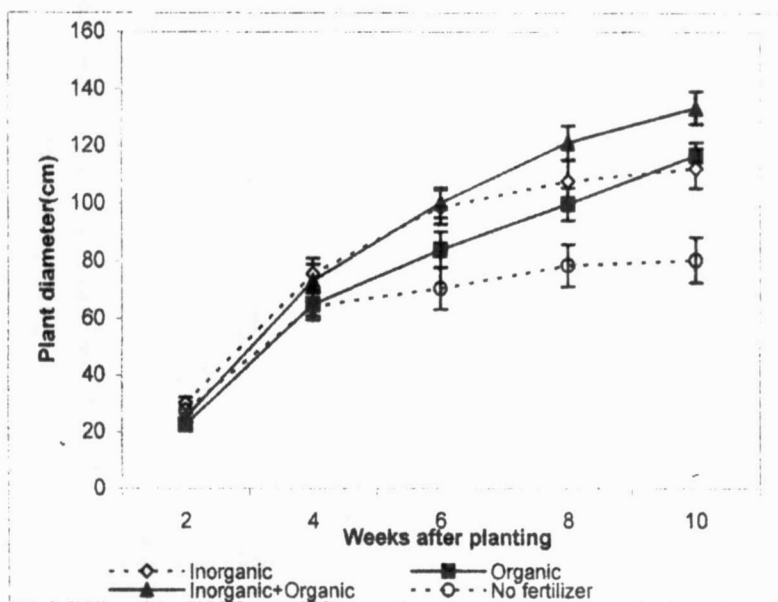


Figure1. Effect of the three modes of fertilizer treatment on the growth in diameter of plants during a 10 week period after establishment

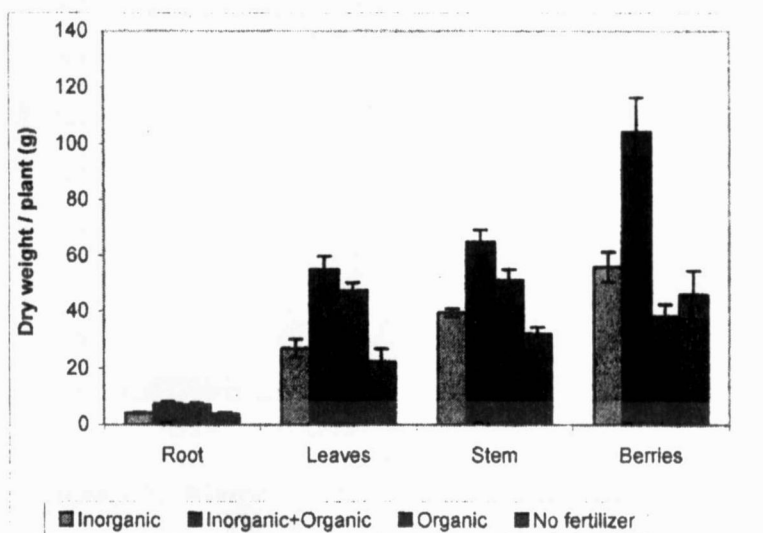


Figure 2. Effect of the three modes of fertilizer treatment on the yield of roots, leaves, stems and berries of plants harvested 120 days after planting

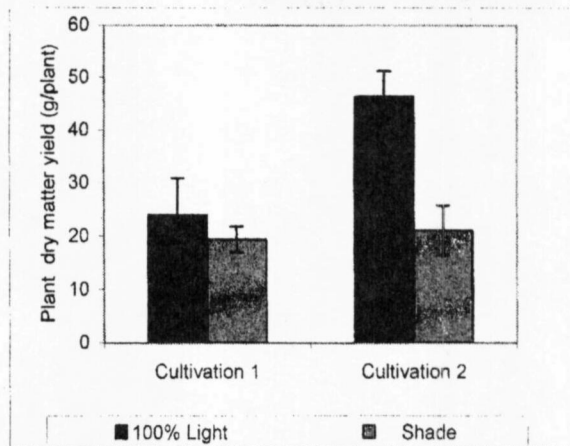


Figure 3. The effect of shade under *Gliricidia* and 100% light on the plant dry matter yield at the two cultivations.

The per plant dry matter yield at the first cultivation in the 100% light treatment did not differ significantly from those under shade. But in the 2nd cultivation, plants under 100% light gave higher yields and were significantly greater than those under shade (Fig. 3).

Effect of the time of harvesting on plant dry matter yield

There were large differences in dry matter yield of plants harvested at 70, 90 and 110 days and were 67.0 g, 215.9g and 231.3g per plant respectively. The dry matter yield of leaves, stems and berries also changed significantly with the age of plants. The dry matter yield of berries was significantly greater in 90 day old plants than in

70 day old plants, but the increase in the 110 day old plants was small. Plants harvested at 90 days also had significantly more stems and leaves than those harvested at 70 days, but those harvested at 110 days did not show such significant differences, although the decrease in the dry weight of leaves at 110 days was considerable (Fig 4). When the yield of leaves, stems and berries were considered as a percentage of the total plant weight, 90 and 110 day old plants had significantly higher percentage of berries than 70 day old plants, while there was a significant reduction in the percentage weight of leaves and stems in 90 and 110 day old plants (Fig 5).

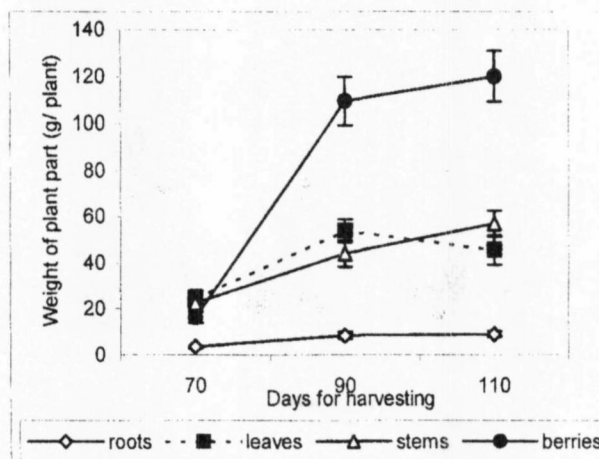


Figure 4. Effect of harvesting at 70, 90 and 110 days after planting on the dry matter yield of leaves, stems berries and roots of plants

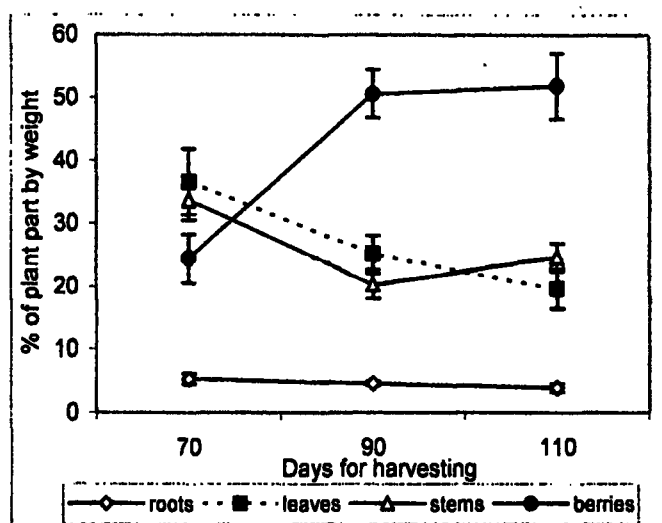


Figure 5. Effect of harvesting at 70, 90 and 110 days after planting on the percentage of leaves, stems berries and roots of plants

DISCUSSION

S. virginianum showed good response to added fertilizer either as organic or inorganic. But 15,000 kg/ha organic fertilizer (cowdung) as basal and a supplementary dose of 200 kg/ha inorganic fertilizer one month after gave the best results. The large increase in the yield of leaves, stems and particularly of the berries indicates the advantage of such combined applications of fertilizer (Dikshit and Khatic 2002). Organic fertilizer only treatment also showed a sustained response up to the 10th week due to the maintenance of available nutrients for a longer period (Chattopadhyay *et.al.* 1993). The declining response shown in the inorganic fertilizer treatment after 6 weeks is possibly due to the insufficiency of nutrients at this rate of application. The low yield of berries and the increased weight of leaves and stems in the organic fertilizer only treatment compared with the inorganic fertilizer treatment may be either due to a deficiency or an effect of organic fertilizer enhancing vegetative growth.

The dry weight of plants under shade and 100% light at the 1st cultivation did not differ significantly possibly because of the sufficiency of light under *Gliricidia* at this stage. In the 2nd cultivation the large increase in dry matter yield in plants under 100% light could be due to the

residual effect of fertilizer from the previous cultivation. Such an effect was not seen in the shade treatment and could be attributed to the increase in shade at the time of the 2nd cultivation. Competition from the roots of *Gliricidia* also could have contributed to this decline in dry matter yield (Schroth and Zech 1995).

S. virginianum plants are generally harvested when they start drying in the field. Our data shows that harvesting at advanced stages of growth gives higher total dry matter yields. But the difference in dry matter yield of plants harvested at 70 and 90 days was 148.9g, and between 90 and 110 day old plants was 15.4g indicating a slowing down of the growth of plants after 90 days. One reason for such an effect could be due to the decrease in the conversion ratio of intercepted light after flowering as seen in many canopies (Stirling *et.al.* 1990). Older plants also consist of more berries and less leaves due to the loss of leaves. Shedding of leaves and continuous production of flowers after flower initiation in this type of herbaceous plants are common (Littleton *et.al.* 1979).

This data shows that there is a large difference in the composition of leaves, stems and berries in plants harvested at 70, 90 and 110 days after establishment. Therefore if the composition of plant parts in the dried product is considered

important, the physiological maturity may not be a suitable criterion in determining the time of harvesting of *S. virginianum* for medicinal uses.

This data also shows that the type of fertilizer changes the composition of plants with respect to the yields of stems, leaves and berries and is a very significant factor that needs consideration when developing agronomic practices for *S. virginianum*.

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