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Short communication

Impact of Soil Moisture on Growth, Yield and Nodulation of Mung Bean (*Vigna radiata*) Growing in the Yala Season on Non Calcic Brown Soils

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ABSTRACT. *Mungbean is a very important grain legume in Sri Lanka, grown in the drier region due to its adaptability to moisture stress. A field study was carried out to evaluate different irrigation schedules to ascertain the impact of soil moisture on growth, yield and nodulation of mungbean. Growth, yield and nodulation were higher in flat beds than in ridge and furrow systems of land preparation. The growth and nodulation parameters were significantly higher with the three day irrigation schedule, while the maximum yield was obtained at the six day irrigation schedule. The results revealed that a frequent irrigation increases vegetative growth at the expense of seed yields and provides evidence for possible irrigation schedules for optimizing yields of this important legume grown in the dry region of Sri Lanka in the Yala season.*

INTRODUCTION

Mung bean is a very important grain legume of the rain fed farming systems in dry zone of Sri Lanka and is grown in the post monsoon period. The crop is primarily cultivated in the late *yala* period when the water requirements for main crops or vegetable cannot be met. However, mung bean showed 40-60% reduction in grain yield due to water stress when compared to irrigated crops (Sadasivam *et al*., 1988). Furthermore, it is also sensitive to soil acidity, alkalinity and salinity. Mung bean is tolerant to high temperature ranges between 20-40^{0}C as it is a drought tolerant crop. However, best temperature range for mung bean is 30-35^{0}C (Tickoo and Jain, 1988).

Nitrogen is the most limiting nutrient for plant growth in the tropics. The symbiotic bacteria lives in root nodules utilize nitrogen gas from the soil air and transform it into ammonia (NH_3) and convert into ammonium (NH_4^+) which can be used by the plant (Guan *et al*., 1995). Effective nodulation is very important to fix nitrogen, which is affected by several above ground and below ground factors. Soil moisture availability would be a key factor for successful nodulation. Therefore, information on effective nodulation in relation to the moisture status of soil and its impact on the yield would be useful for an effective water management.

This study was conducted to evaluate impact of different soil moisture regimes on growth, yield and nodulation of mung bean in *yala* season in the dry zone of Sri Lanka. The main objective of the study was to assess suitable irrigation intervals for mung bean cultivated in the *yala* season in the Mahawali System B region and the specific objectives were to evaluate the effect of different soil moisture level and the different types of planting beds on growth, yield and nodulation of mung bean.

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MATERIALS AND METHODS

The experiment was carried out as a two factor factorial design with two bed types (Ridge & Furrow and Flat beds) and four different irrigation schedules, the treatment one (T1) three days irrigation intervals, treatment two (T2) six days irrigation interval, treatment three (T3) nine days irrigation interval and treatment four (T4) zero irrigation. The experiment had four replicates with a plot size 4 X 4 m plots. Soil samples were collected from 0-15 cm and 15-30 cm depths to determine soil moisture content at three day intervals. Leaf area, shoot and root dry weight and effective nodulation were measured as growth and nodulation parameters. As the yield parameters, days to flowering, number of pods per plant, number of seeds per pod, 100 seeds weights and yield were measured. Data collected were analyzed to evaluate the effect of bed type and irrigation using the SAS statistical package.

RESULTS AND DISCUSSION

Moisture content

Moisture content of the experiment plots showed a similar pattern of variation, i.e flat bed as well as ridge and furrow land preparation types with respect to irrigation (Fig. 1). Moisture retention was not influenced by the land preparation methods as soil is sandy soil. Moisture content of three days irrigation schedule was above 12% which is near in field capacity. Generally, field capacity of NCB soil is 14% moisture content.

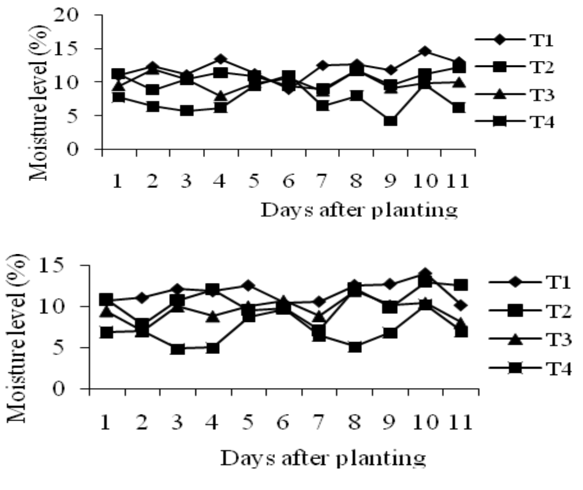

Figure 1. Variation of soil moisture content of flat bed and ridge and furrow bed types at 0-15 cm depth

T1, T2, T3 and T4 depict irrigation intervals of three days interval, six days intervals, nine days interval and zero irrigation respectively.

Effect of irrigation schedules and bed types on plant growth

Table 1. Leaf and shoot growth of mung bean as affected by planting method and irrigation frequency

Bed type	Irrigation schedules	Leaf area at flowering stage (cm^2)	Leaf area at harvesting stage (cm^2)	Shoot dry wt. at flowering stage (g)	Shoot dry wt. at harvesting stage (g)
Flat bed	T1	406.87	259.25	3.14	4.01
	T2	392.12	263.50	2.75	3.41
	T3	390.62	313.50	2.99	3.74
	T4	355.00	230.25	1.82	2.35
Ridge & furrow	T1	373.62	249.75	2.55	2.57
	T2	311.37	278.25	2.12	2.44
	T3	277.50	216.25	1.84	2.35
	T4	329.12	196.50	1.92	2.11
CV%		30.40	41.56	30.19	38.81
Probability	Bed type	0.109	0.403	0.037	0.081
Probability	Irrigation	0.729	0.690	0.091	0.290
Probability	Interaction	0.825	0.736	0.409	0.690

The interaction between planting method and irrigation frequency on development of leaf area and shoot dry weight were not significantly different (Table1). Plant grown on the flat beds had a greater leaf area than in those grown in the ridge and furrow system. The plants grown in flat beds with an irrigation frequency of three day intervals (T1) had the highest leaf area and shoot dry weights. This suggests that optimal shoot growth of mung bean could be obtained by growing on flat beds with an irrigation frequency of three day intervals in the *yala* season on Non Calcic Brown Soil found in the dry zone of Sri Lanka.

Effect of irrigation schedules and bed types on root growth

Table 2. Root growth of mung bean as affected by planting method and irrigation frequency

Bed type	Irrigation schedules	Root length at flowering (cm)	Root length at harvesting (cm)	Root dry weight at flowering (g)	Root dry weight at harvesting (g)
Flat bed	T1	72.58	43.80	0.48	0.49
	T2	45.47	52.64	0.40	0.43
	T3	50.38	41.44	0.49	0.54
	T4	38.79	48.32	0.21	0.28
Ridge & furrow	T1	50.38	29.66	0.42	0.35
	T2	35.94	52.64	0.27	0.35
	T3	45.96	24.35	0.31	0.38
	T4	32.80	38.45	0.22	0.28
CV%		23.83	38.45	31.09	40.71
Probability	Bed type	0.013	0.292	0.030	0.113
Probability	Irrigation	0.0009	0.309	0.002	0.177
Probability	Interaction	0.388	0.128	0.357	0.767

The interaction between planting method and irrigation frequency on development of roots and nodules (Table 2) of mung bean were not significantly different. This reveals that there is no impact of type of bed on root growth of mung bean, but there is similar influence of irrigation schedules on root growth.

Root length and root dry weight at the flowering stage showed significant differences, but at the harvesting stage there was no impact in both parameters. The highest root growth was observed in flat beds compared to the ridge and furrow bed types. This indicates the advantage of flat bed in dry seasons for moisture conservation.

Effect of irrigation schedules and bed types on nodulation

Table 3. Nodulation of mung bean as affected by planting method and irrigation frequency

Bed type	Irrigation schedules	Number of nodules at flowering
Flat bed	T1	68.50
	T2	17.12
	T3	9.12
	T4	8.12
Ridge & furrow	T1	24.75
	T2	8.50
	T3	15.5
	T4	9.75
CV%		39.87
Probability	Bed type	0.0008
Probability	Irrigation	0.0001
Probability	Interaction	0.0001

The interaction between irrigation schedules and bed types (Table 3) was significant in the flowering stage. At the harvesting stage there was no significant difference observed. This may due to low substrate available to nodules. Nodulation of mung bean was influenced by the frequency of irrigation as well as the type of beds. A higher number of nodules could be observed in plants grown in flat beds with an irrigation schedule of three day intervals. This reveals that the frequency of irrigation has a significant impact on nodulation of mung bean.

Effect of yield

Table 4. Means of yield parameters as affected by irrigation frequency

Irrigation schedules	No of pods / plant	No of seed / pod	100 seeds Wt (g)	Yield / plot (g)
T1	7.75[a]	9.62[a]	6.24[a]	308.98[ab]
T2	7.87[a]	10.00[a]	6.55[ab]	424.42[a]
T3	7.37[a]	10.12[a]	6.51[bc]	315.75[ab]
T4	6.62[a]	9.37[a]	6.23[c]	267.46[b]
CV %	23.38	11.23	3.85	44.56

Means in a column followed by the same letter are not significantly different at p=0.05

The impact of different irrigation schedules (Table 4) showed significant differences for 100 seeds weight and seed yield. The soil moisture is a critical factor for the crop growth and pod filling of mung bean. This study reveals that irrigation frequency of six days intervals would optimize the crop growth and yield when mung bean is grown on flat beds in *Yala* season on Non Calcic Brown soil found in the dry zone of Sri Lanka.

CONCLUSIONS

The growth, nodulation and yield of mung bean were higher in flat beds than in ridge and furrow systems of land preparation. Growth and nodulation parameters were significantly higher with the three day irrigation schedule, while the maximum yield was obtained at the six day irrigation schedule. The results provides evidence for possible irrigation schedules for optimizing yields of mung bean, grown in the dry regions of Sir Lanka in the *yala* season,

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