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Effect of Foliar Application of Nutrients to Enhance Productivity through Combating the Dry Spell Effect in Cowpea

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Abstract

Field experiment was conducted at UAS, Bangalore during 2019 with 8 treatments to evaluate the effect of foliar application of nutrients to enhance productivity through combating the dry spell effect in cowpea. The results showed that among different treatments, foliar spray of soluble NPK (19:19:19) @ 1 per cent concentration at flower initiation and pod formation stage recorded higher growth parameters *viz.,* plant height (33.9 cm) and number of branches (8.2), yield and yield related parameters *viz.,* number of pods (21.3), number of seeds (17.1), pod length (15.9 cm) and seed yield (1738 kg ha^{-1}) and the same treatment also recorded higher gross returns (52140 Rs ha^{-1}), net returns (26143 Rs ha^{-1}) and B:C ratio (2.0) but it was on par with the treatment foliar spray of soluble NPK (19:19:19) @ 1 per cent concentration at pod formation stage.

Keywords : Anther culture, Arka Meghana, Callogenesis, Embryogenesis, Incubation conditions

Cowpea [*Vigna unguiculata* (L.) Walp] is an annual legume of tropical and subtropical area, commonly known as *lobia*. It is a drought tolerant and warm-weather crop, which is well adapted to the drier regions of the tropics. In India, cowpea is grown in an area of 3.9 million hectares, particularly in western, central and peninsular regions.

The crop is known for initial fast growth, extensive root development and early establishment of the crop in wake of drought like situation. It has the ability to fix atmospheric nitrogen through its root nodules and it grow well in poor soils with more than 85 per cent sand and with less than 0.2 per cent organic matter and low levels of phosphorus. It also has the excellent ability against soil erosion from rain water and being denoted as a prominent cover crop.

For any crop, fertilizer is the most critical input for utilizing the yield potential of improved high yielding crop varieties. However, in recent days *i.e.,* post green revolution era, due to indiscriminate nutrient mining, soil fertility is depleting at an alarming rate and to provide food for growing human population, there is a need to add fertilizers to augment the sustainable crop production. However, root is common to be first part of plant that absorbs nutrients from soils, but nutrients availability might be restricted; then affects fertilizer efficiency. So, it is better to recommend foliar application of KNO_3 that provides nutrients for plant (Altindisl *et al*., 1998).

In fact, foliar fertilization is applied in small droplets on the leaves and stems of the plant; then nutrients are absorbed through these parts of plants which can supply the nutrients for plants rapidly to obtain high performance guarantee. (Kuepper, G. 2003). From an ecological perspective, foliar fertilization is more acceptable, because the small amounts of nutrients is used for rapid use by plants (Stampar *et al*., 1998).

Cowpea an important component of traditional intercropping system, especially in the complex and elegant subsistence farming systems of dry regions. Research on foliar application of nutrients for cowpea during dry spell was meagre hence the present investigation was carried out to evaluate the effect of foliar application of nutrients to enhance productivity through combating the dry spell effect in cowpea.

Material and Methods

A Field experiment was conducted at Zonal Agricultural Research Station, GKVK, Bengaluru during 2019. The experiment was laid out in Randomized Complete Block Design with eight treatments (T_1: Absolute control; T_2: Water spray; T_3: Foliar spray of soluble NPK (19:19:19) @ 1 per cent at flower initiation stage; T_4: Foliar spray of soluble NPK (19:19:19) @ 1 per cent at pod formation stage; T_5: Foliar spray of soluble NPK (19:19:19) @ 1 per cent at flower initiation & pod formation stage; T_6: Foliar spray of soluble KNO_3 @ 0.5 per cent at flower initiation stage; T_7: Foliar spray of soluble KNO_3 @ 0.5 per cent at pod formation stage; T_8: Foliar spray of soluble KNO_3 @ 0.5 per cent at flower initiation & pod formation stage) treatments replicated thrice.

The cowpea was sown in a plot size of 4.5 m × 4 m (25.2 m^2) for each treatment. one seed per hill were sowed to a depth of 5 cm on distance between row to row (45 cm) and plant to plant (10 cm). Plant protection measures, weed management practices and irrigation practices were common for all treatments.

Results and Discussion

Growth and Yield Parameters

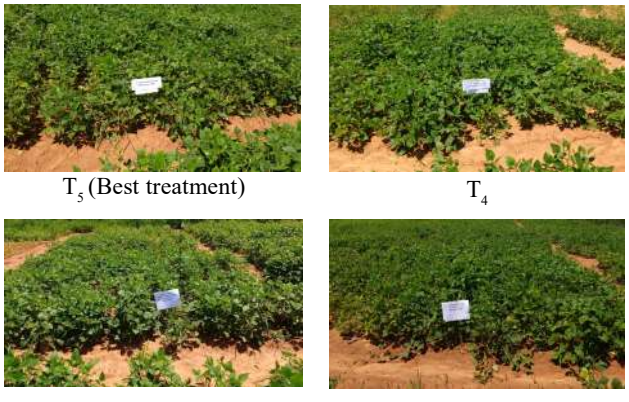
The results of the field experiment conducted to evaluate the effect of foliar application of nutrients to enhance productivity through combating the dry spell effect in cowpea were presented in Tables 1 & 2 and Fig 1 & 2. The experimental results revealed that foliar spray of soluble NPK (19:19:19) @ 1 per cent concentration at flower initiation and pod formation stage recorded higher plant height (33.9 cm), number of branches (8.2), leaf area (9 49 $plant^{-1}$), total dry

Table 1

Chemical and nutrient status of the experimental site

Parameter	Status
pH	5.69 - 5.89
EC (dSm^{-1})	0.08 - 0.09
Organic carbon (%)	0.43 - 0.50
Available N (kg ha^{-1})	125.8 - 151.1
Available P_2O_5 (kg ha^{-1})	16.6 - 19.2
Available K_2O (kg ha^{-1})	93 - 124.6
Exchangeable Ca. (me/100g)	2.3 - 2.7
Exchangeable Mg. (me/100 g)	0.7 - 0.9
Available S. (ppm)	3.47 - 4.21
Available Fe (ppm)	13.19 - 24.00
Available Zn (ppm)	1.40 - 2.43
Available Cu (ppm)	0.79 - 1.99
Available Mn (ppm)	24.19 - 36.14

Fig. 1: General view of the experimental site



T_5 (Best treatment) T_4

T_3 T_6

Fig. 2: Cowpea as influenced by foliar application of nutrients

TABLE 2

Growth parameters as influenced by foliar application of nutrients to enhance productivity through combating the dry spell effect in cowpea

Treatments	Plant height (cm)	No. of Branches	Leaf area (cm^2 $plant^{-1}$)	Total dry matter (g $plant^{-1}$)
T_1: Absolute control	26.4	4.2	589	8.87
T_2: Water spray	27.9	5.3	611	9.24
T_3: Foliar spray of soluble NPK (19:19:19) @ 1% at flower initiation stage	31.6	7.2	811	10.88
T_4: Foliar spray of soluble NPK (19:19:19) @ 1% at pod formation stage	32.7	7.6	845	11.22
T_5: Foliar spray of soluble NPK (19:19:19) @ 1% at flower initiation & pod formation stage	33.9	8.2	949	13.78
T_6: Foliar spray of soluble KNO_3 @ 0.5% at flower initiation stage	30.3	5.9	658	9.68
T_7: Foliar spray of soluble KNO_3@ 0.5% at pod formation stage	30.7	6.4	712	10.21
T_8: Foliar spray of soluble KNO_3 @ 0.5% at flower initiation & pod formation stage	31.4	7.0	784	10.58
S.Em. ±	0.92	0.2	36	0.85
CD (p=0.05)	2.83	0.6	110	2.55

matter production (13.78 g $plant^{-1}$) number of pods (21.3), number of seeds (17.1), pod length (15.9 cm) and seed yield (1738 kg ha^{-1}) which was on par with the foliar spray of soluble NPK (19:19:19) @ 1 per cent concentration at pod formation stage and recorded plant height (32.7 cm), leaf area (845 $plant^{-1}$), total dry matter production (11.22 g $plant^{-1}$) number of branches (7.6), number of pods (20.5), number of seeds (16.6), pod length (14.8 cm) and seed yield (1684 kg ha^{-1}). Reflection of increase in vegetative growth, yield and its components as shown in Table 1 and 2 were might be due to foliar spray of NPK compared to control which provides balanced supply of nutrients and rapid absorption by the plants.

TABLE 3

Yield and yield related parameters as influenced by foliar application of nutrients to enhance productivity through combating the dry spell effect in cowpea

Treatments	No. of Pods	No. of seeds	Pod length (cm)	Seed yield (kg ha^{-1})
T_1: Absolute control	13.6	14.0	10.9	1023
T_2: Water spray	14.2	14.3	12.1	1212
T_3: Foliar spray of soluble NPK (19:19:19) @ 1% at flower initiation stage	18.2	16.0	14.4	1611
T_4: Foliar spray of soluble NPK (19:19:19) @ 1% at pod formation stage	20.5	16.6	14.8	1684
T_5: Foliar spray of soluble NPK (19:19:19) @ 1% at flower initiation & pod formation stage	21.3	17.1	15.9	1738
T_6: Foliar spray of soluble KNO_3 @ 0.5% at flower initiation stage	15.6	15.3	13.6	1436
T_7: Foliar spray of soluble KNO_3@ 0.5% at pod formation stage	16.4	15.5	14.0	1519
T_8: Foliar spray of soluble KNO_3 @ 0.5% at flower initiation & pod formation stage	17.3	16.2	14.3	1575
S.Em. ±	0.4	0.2	0.3	38
CD (p=0.05)	1.2	0.6	0.9	116

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The importance of foliar fertilization be accounted by its essential role in respiration, their metabolism activation of the enzyme, photosynthesis, chloroplast formation, chlorophyll synthesis and natural hormone biosynthesis (Dhakal *et al*., 2016). Application of 19:19:19 fertilizers recorded faster growth and inturn enhanced the yield of cowpea in red sandy soils by Kuntoji and Subbarayappa (2021) Increased dry matter accumulation in pulse crop through Urea, KCl & Zinc was also observed by Chatterjee and Bhattacharya (1986) & Chandrasekhar and Bangarusamy (2003). Fatokun (2002) reported that the application of 19:19:19 NPK @ 3 per cent recorded the highest uptake of nitrogen, phosphorous and potassium by cowpea grain, stover as well as total uptake compared to rest of the treatments. The increased uptake of these nutrients by cowpea was due to increase in grain and stover yield and N, P and K content of grain and stover under the different organic sources (Giller 2007). On the other hand foliar application of NPK at pod formation stage recorded on par results, this signifies that foliar application of nutrients at one stage is sufficient to record higher growth and yield parameters.

Economics of cowpea cultivation was presented in Table 4 Foliar spray of soluble KNO_3 @ 0.5 per cent concentration at flower initiation and pod formation stage recorded higher cost of cultivation (26050 Rs. ha^{-1}) but higher gross returns (52140 Rs. ha^{-1}), net returns (26143 Rs. ha^{-1}) and B:C ratio (2.0) was recorded in the treatment, foliar spray of soluble NPK (19:19:19) @ 1 per cent concentration at flower initiation and pod formation stage which was on par with the treatment foliar spray of soluble NPK (19:19:19) @ 1 per cent concentration at pod formation stage and recorded gross returns (50520 Rs. ha^{-1}), net returns (25223 Rs. ha^{-1}) and B:C ratio (1.99). Similar results were recorded by Kuepper (2003) : Sinchana and Subbarayappa (2021) and reported that foliar application NPK for cowpea improved the net income similar observations were recorded in maize by Kuntoji and subbarayappa (2021). Stampar *et al.,* 1998 reported that foliar application of NPK at 2 per cent spray during pod filling stage enhanced the income and net returns to the tune of 12 per cent higher compared to the control treatment.

TABLE 4

Economics of cowpea as influenced by foliar application of nutrients to enhance productivity through combating the dry spell effect in cowpea

Treatments	Cost of cultivation (Rs ha^{-1})	Gross Returns (Rs ha^{-1})	Net Returns (Rs ha^{-1})	B:C Ratio
T_1: Absolute control	24592	30690	6098	1.24
T_2: Water spray	24842	36360	11518	1.46
T_3: Foliar spray of soluble NPK (19:19:19) @ 1% at flower initiation stage	25297	48330	23033	1.91
T_4: Foliar spray of soluble NPK (19:19:19) @ 1% at pod formation stage	25297	50520	25223	1.99
T_5: Foliar spray of soluble NPK (19:19:19) @ 1% at flower initiation & pod formation stage	25997	52140	26143	2.00
T_6: Foliar spray of soluble KNO_3 @ 0.5% at flower initiation stage	25350	43080	17730	1.69
T_7: Foliar spray of soluble KNO_3@ 0.5% at pod formation stage	25350	45570	20220	1.79
T_8: Foliar spray of soluble KNO_3 @ 0.5% at flower initiation & pod formation stage	26050	47250	21200	1.81
S.Em. $\pm$	-	1011	521	0.01
CD (p=0.05)	-	3056	1612	0.04

Foliar spray of soluble NPK (19:19:19) @ 1 per cent concentration during flower initiation and pod formation stage recorded higher growth, yield and yield related parameters and the same treatment recorded higher economics in cowpea production but the treatment foliar spray of soluble NPK (19:19:19) @ 1 per cent concentration during pod formation stage recorded on par results hence from the economic point of view foliar application of NPK (19:19:19) @ 1 per cent at pod formation stage is recommended for farmers.

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