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Bio-Stimulants for Better Growth and Yield Potency in Cowhage (*Mucuna pruriens* L.)

B. R. Sharanya[1], A. P. Mallikarjuna Gowda[2] and K. N. Srinivasappa[3]
[1 & 3] Department of Horticulture, College of Agriculture, UAS, GKVK, Bengaluru - 560 065
[2]Senior Farm Superintendent, ZARS, UAS, GKVK, Bengaluru-560 065
e-Mail : sharanyagowda777@gmail.com

Authors Contribution

B. R. Sharanya : Interpritation and data analysis;
A. P. Mallikarjuna Gowda : Finalising the paper;
K. N. Srinivasappa : Valuable input to conduct experiment

Corresponding Author :
B. R. Sharanya
Department of Horticulture, College of Agriculture, UAS, GKVK, Bengaluru

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Abstract

An experiment was conducted at ICAR - Krishi Vigyan Kendra (KVK), Hadonahalli, Doddaballapura taluk during 2020 - 2021, to evaluate the effect of bio-stimulants for better growth and yield potency in cowhage. Experiment consisted of soil and foliar application of humic acid, amino acid, sea weed extract and microbial consortia based bio-stimulants. The experiment was conducted by adopting randomized complete block design (RCBD) consisting 9 treatments with three replications. Maximum plant height (359.64 cm), number of branches (8.18), number of leaves (87.16), number of pods plant^{-1} (63.19), pod weight (354.76 g plant^{-1}), seed weight (161.42 g plant^{-1}) and seed yield (41.73 q ha^{-1}) were recorded with RDF+ foliar application of humic acid based bio-stimulant. Higher test weight (115.95 g) was observed with RDF + foliar application of sea weed extract based bio- stimulant. Lower growth and yield attributes were found in control.

Keywords : Cowhage, RDF, Bio-stimulants, Humic acid, Sea weed extract, Foliar spray

Cowhage is popularly known as mucuna and velvet bean belongs to the family Fabaceae and known as Nasugunnikayi in Kannada and Atmagupta in Sanskrit. It is indigenous to tropical regions especially Africa, India and West Indies. It is an annual, herbaceous climber having a diploid genome with 22 pairs of chromosomes (2n = 2x = 22). The cowhage is widespread in tropical and sub-tropical regions of the world as one among the various under-utilized legumes.

In India, 14 species are found in the foothills of the Himalayas, the plains of West Bengal, Madhya Pradesh, Karnataka, Kerala, Andhra Pradesh, Uttar Pradesh and Andaman & Nicobar Islands. Amongst these, *M. pruriens*, *M. pachylobia* and *M. utilis* are cultivated for their young leaves and pods which can be used as a fodder and vegetable.

The seeds of mucuna contain L-DOPA (L-3, 4 dihydroxy phenylalanine) which is a non protein amino acid, widely used as an anti-Parkinson and hypertensive drug. The percentage of this chemical on a crude weight basis is about 4.0 per cent and in crystalline form is 2-2.5 per cent. It is also used as an anti-diabetic, aphrodisiac, as a nervine tonic, in treating scorpion stings, leucorrhoea, spermatorrrhoea and menstrual disorders. It is considered as viable source of dietary proteins (Janardhanan *et al*., 2003 and Pugalenthi *et al*., 2005) due to its high protein content (23–35%) in addition to its digestibility, which is comparable with other pulses such as soybean, rice bean and lima bean (Gurumoorthi *et al*., 2003). The seeds also contain phytic acid, oligosaccharides, glutathione, mulhingallic acid and a number of alkaloids *viz*., mucunine, mucunadine. nicotine, prurienine and prurinidine. The seed kernel oil contains sitosterol and lecithin.

In recent years, plant bio-stimulants are being extensively used in farming due to their beneficial

effects. A plant bio-stimulant is any substance or microorganism applied to plants with the aim to enhance nutritional efficiency, abiotic stress tolerance and/or crop quality traits, regardless of its nutrients content. The use of bio-stimulants is safe for both human being and for the environment and in particular for reducing chemicals in agriculture. Bio-stimulants are having impact on several metabolic activities such as respiration, photosynthesis, nucleic acid synthesis and ion uptake. It also contributes to plant growth, yield and it diminish the effects of stress and improves water holding capacity. Application of different plant bio-stimulants in various concentrations and diverse mechanisms of action has resulted beneficial effects on medicinal plants (Rafiee *et al*., 2016).

The availability of scientific information on use of bio-stimulants in medicinal crops is very limited in general and cowhage in particular. Therefore, an attempt was made to study the role of bio-stimulants for better growth and yield potency in cowhage.

Material and Methods

The field experiment was conducted at ICAR - Krishi Vigyan Kendra, Hadonahalli, Doddaballapur Tq. Bengaluru Rural Dist, which is situated under the agro-climatic zone V: (Eastern dry zone) of Karnataka at $12^0$58' North latitude and $77^0$35' East longitude with an altitude of 896 m above MSL. The soil of the experimental site was red soil. The experiment included 9 treatments laid out in RCBD with three replications. Treatments involved soil and foliar application of bio-stimulants *viz.*, T_1-RDF (Control), T_2-RDF+ Soil application of Humic acid based bio-stimulant, T_3- RDF+ Foliar application of Humic acid based bio-stimulant, T_4- RDF+ Soil application of Amino acid based bio-stimulant, T_5- RDF+ Foliar application of Amino acid based bio-stimulant, T_6- RDF+ Soil application of Sea weed extract based bio-stimulant, T_7- RDF+ Foliar application of Sea weed extract based bio-stimulant, T_8 -RDF+ Soil application of Microbial based bio-stimulant, T_9- RDF+ Foliar application of Microbial based bio-stimulant. The cowhage variety Arka Dhanwantari seeds were sown in lines at the rate of 30 kg/ha with a depth of 2 cm, maintaining 60 cm row to row and 60 cm plant to plant spacing. The soil was fertilized with 100 : 80 : 40 kg N:P:K/ ha and 15 t/ ha FYM before sowing. The different bio-stimulants *viz.*, Humic acid @ 3 ml/l, Amino acid @ 3 ml/l, Sea weed extract @ 1 ml/l, Arka microbial consortia @10 ml/ l were applied to the crop at 30 and 60 days after sowing, maintaining the quantity of 1500 l/ ha for soil application and 750 l/ha for foliar application.

Results and Discussion

Plant Growth

Plant height was significantly influenced by application of different bio-stimulants. Maximum vine length (249.40, 282.98, 315.23 and 359.64 cm at 60 DAS, 90 DAS, 120 DAS and at harvest, respectively) was noticed with T_3- RDF+ foliar application of humic acid based bio-stimulant, which was followed by T_7- RDF+ foliar application of sea weed extract based bio-stimulant (225.80, 261.80, 292.13 and 323.13 cm) and T_2- RDF+ soil application of humic acid based bio-stimulant (210.6, 241.53, 272.13 and 311.47 cm). While, plants applied with only RDF (T_1) recorded shorter vine length at all the growth stages (Table 1).

T_3- RDF + Foliar application of humic acid based bio-stimulant resulted in maximum number of branches (6.23 and 8.18 at 60 & 120 DAS, respectively) which was *on par* with T_7- RDF + foliar application of sea weed extract based bio-stimulant (6.03 and 7.58 at 60 & 120 DAS, respectively). Lesser numbers of branches were found with control-T_1 (Table 2).

Plants supplied with T_3 - RDF + foliar application of humic acid based bio-stimulant produced maximum number of leaves (74.61, 87.16 at 60 & 90 DAS, respectively) which was *on par* with T_7- RDF + foliar application of sea weed extract based bio-stimulant (68.39 and 82.78 at 60& 90 DAS, respectively). Whereas plants supplied with only RDF resulted in lesser number of leaves (Table 2).

The increase in plant height, number of branches and number of leaves might be due to the beneficial effect of humic acid on plant growth in terms of promoting

TABLE 1

Effect of bio-stimulants on vine length of cowhage

Treatments	Vine length (cm)			
	60 DAS	90 DAS	120 DAS	At harvest
T_1 - Control	156.47 ^{f}	178.50 ^{f}	195.53 ^{g}	226.07 ^{f}
T_2 - RDF+ Soil application of Humic acid based bio-stimulant	210.60 ^{bc}	241.53 ^{bc}	272.13 ^{c}	311.47 ^{b}
T_3 - RDF+ Foliar application of Humic acid based bio-stimulant	249.40 ^{a}	282.98 ^{a}	315.23 ^{a}	359.64 ^{a}
T_4 - RDF+ Soil application of Amino acid based bio-stimulant	181.27 ^{de}	203.13 ^{e}	231.24 ^{e}	268.20 ^{cd}
T_5 - RDF+ Foliar application of Amino acid based bio-stimulant	204.33 ^{c}	226.10 ^{cd}	253.99 ^{cd}	286.47 ^{c}
T_6 - RDF+ Soil application of Sea weed extract based bio-stimulant	190.33 ^{cd}	212.07 ^{de}	239.07 ^{de}	278.61 ^{cd}
T_7 - RDF+ Foliar application of Sea weed extract based bio-stimulant	225.80 ^{b}	261.80 ^{b}	292.13 ^{b}	323.13 ^{b}
T_8 - RDF+ Soil application of Microbial based bio-stimulant	166.47 ^{ef}	195.37 ^{ef}	210.27 ^{fg}	242.03 ^{ef}
T_9 - RDF+ Foliar application of Microbial based bio-stimulant	172.77 ^{def}	204.53 ^{e}	227.04 ^{ef}	258.13 ^{de}
S.Em.±	6.83	6.81	6.64	7.73
CD@5%	20.49	20.40	19.90	23.16

Note: DAS – Days after sowing

nutrient uptake and nutritional status especially nitrogen, potassium and phosphorous necessary for plant growth. In addition, it is acting as a source of plant growth hormones, carbohydrates, amino acids and vitamins. In the case of foliar application of sea weed extract, it was speculated that, the increase in plant height might have been a result of macronutrients and N-containing plant growth regulators (auxins and cytokinins) within the sea weed extract that were absorbed by the plants. In addition to this, the presence of molecules such as organic acids, methionine and even aminoacids in

TABLE 2

Influence of bio-stimulants on number of branches and number of leaves in cowhage

Treatments	No. of branches		No. of leaves	
	60 DAS	120 DAS	60 DAS	90 DAS
T_1 - Control	3.50 ^{e}	4.53 ^{e}	49.07 ^{f}	65.67 ^{e}
T_2 - RDF+ Soil application of Humic acid based bio-stimulant	5.63 ^{abc}	7.36 ^{abc}	65.87 ^{bc}	80.77 ^{b}
T_3 - RDF+ Foliar application of Humic acid based bio-stimulant	6.23 ^{a}	8.18 ^{a}	74.61 ^{a}	87.16 ^{a}
T_4 - RDF+ Soil application of Amino acid based bio-stimulant	5.10 ^{c}	6.50 ^{cd}	58.11 ^{de}	72.67 ^{cd}
T_5 - RDF+ Foliar application of Amino acid based bio-stimulant	5.47 ^{bc}	7.10 ^{bcd}	60.52 ^{cd}	77.61 ^{bc}
T_6 - RDF+ Soil application of Sea weed extract based bio-stimulant	5.40 ^{bc}	6.85 ^{bcd}	62.60 ^{bcd}	74.12 ^{cd}
T_7 - RDF+ Foliar application of Sea weed extract based bio-stimulant	6.03 ^{ab}	7.58 ^{ab}	68.39 ^{ab}	82.78 ^{ab}
T_8 - RDF+ Soil application of Microbial based bio-stimulant	4.27 ^{d}	6.32 ^{d}	53.76 ^{ef}	69.38 ^{de}
T_9 - RDF+ Foliar application of Microbial based bio-stimulant	4.20 ^{de}	6.46 ^{cd}	59.21 ^{de}	71.61 ^{cde}
S.Em. ±	0.40	0.38	2.17	2.05
CD@5%	1.21	1.15	6.52	6.16

Note: DAS - Days after sowing

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sea weed extract could increase nutrient absorption in plants by chelating the available nutrients, thereby increasing their absorbance (Papenfus *et al*., 2013). Increase in plant growth with the application of amino acids might be due to readily available source of growing substances which form the components of protein in the living tissues. Generally, amino acids were found to increase number of vegetative organs in celeriac plant (Shehata *et al*., 2011). These findings were well supported by the work of Sosnowski *et al.* (2017) in medicago, Khaleda *et al.* (2017) in alfalfa and Majid *et al*. (2019) in fenugreek.

Yield

Among the different soil and foliar nutrition treatments, maximum number of pods plant^{-1} (63.19) was recorded with T_3- RDF + foliar application of humic acid based bio-stimulant which was followed by T_7- RDF + foliar application of sea weed extract based bio-stimulant (59.10). Whereas, lesser number of pods were produced in control plants. T_3- RDF + foliar application of humic acid based bio-stimulant resulted in maximum pod weight (354.76 g plant^{-1}) which is *on par* with RDF+ foliar application of sea weed extract based bio- stimulant (336.45 g plant^{-1}) followed by RDF+ foliar application of amino acid based bio- stimulant (305.58 g plant^{-1}). While plants supplied only with RDF recorded less pod weight.

Plants treated with RDF + foliar application of humic acid based bio-stimulant produced maximum seed weight (161.42 g plant^{-1}) and was *on par* with RDF + foliar application of sea weed extract based bio-stimulant (152.82 g plant^{-1}). Whereas control plants recorded less seed weight. Significantly maximum seed yield (41.73 q ha^{-1}) with 66.05 percent increase over control was realised with RDF +foliar application of humic acid based bio-stimulant which was *at par* with RDF + foliar application of sea weed based bio-stimulant (39.66 q ha^{-1}). While lesser seed yield (25.13

TABLE 3

Pod and seed characters as influenced by bio-stimulants in cowhage

Treatments	Number of pods (plant^{-1})	Pod weight (g plant^{-1})	Seed weight (g plant^{-1})	Seed yield (q ha^{-1})	Percent increase in yield over control	B:C ratio
T_1 - Control	31.81 ^{g}	172.41 ^{g}	80.78 ^{h}	25.13 ^{f}	-	0.42
T_2 - RDF+ Soil application of Humic acid based bio-stimulant	49.20 ^{d}	268.78 ^{cd}	125.37 ^{de}	33.46 ^{bcd}	33.4	0.67
T_3 - RDF+ Foliar application of Humic acid based bio-stimulant	63.19 ^{a}	354.76 ^{a}	161.42 ^{a}	41.73 ^{a}	66.05	1.12
T_4 - RDF+ Soil application of Amino acid based bio-stimulant	40.65 ^{f}	227.74 ^{ef}	108.04 ^{fg}	30.37 ^{de}	20.85	0.48
T_5 - RDF+ Foliar application of Amino acid based bio-stimulant	55.51 ^{bc}	305.58 ^{b}	143.53 ^{bc}	36.01 ^{b}	43.29	0.80
T_6 - RDF+ Soil application of Sea weed extract based bio-stimulant	45.12 ^{e}	247.52 ^{de}	116.23 ^{ef}	31.98 ^{cde}	27.25	0.61
T_7 - RDF+ Foliar application of Sea weed extract based bio-stimulant	59.10 ^{b}	336.45 ^{a}	152.82 ^{ab}	39.66 ^{a}	57.81	1.02
T_8 - RDF+ Soil application of Microbial based bio-stimulant	39.71 ^{f}	204.7 ^{f}	98.22 ^{g}	28.58 ^{ef}	13.72	0.41
T_9 - RDF+ Foliar application of Microbial based bio-stimulant	53.60 ^{c}	281.02 ^{c}	134.58 ^{cd}	35.49 ^{bc}	41.22	0.79
S.Em.±	1.21	8.03	3.40	1.15	-	-
CD@5%	3.63	24.06	10.20	3.45	-	-

Note: DAS - Days after sowing

q ha^{-1}) was noticed with control plants. The maximum cost benefit ratio (1: 1.12) was registered with T_3- RDF +foliar application of humic acid based bio-stimulant (Table 3). Maximum test weight (115.95 g) was noticed with RDF + foliar application of sea weed extract based bio-stimulant compared to all the treatments, except with application of RDF +foliar application of humic acid based bio stimulant (113.92 g), while the significant lowest value was recorded in control (Fig. 1).

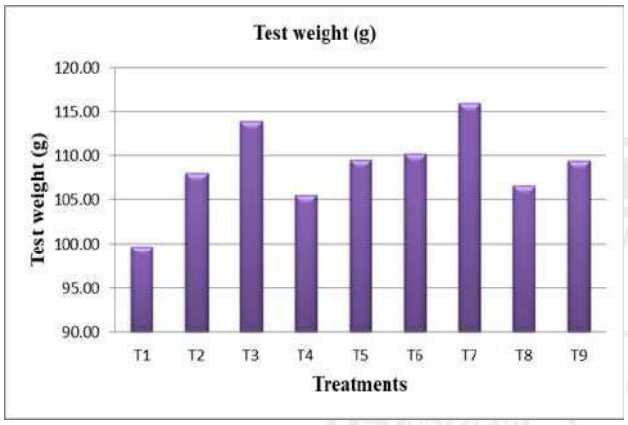

Fig. 1 : Effect of bio-stimulants on test weight in cowhage

Increase in the seed yield might be due to role of humic acid in increasing the enzymes activity that lead to easy translocation of photosynthetic product from the leaves to reproductive organs. Increased yield attributing parameters like plant height, number of branches and number of leaves helped to produce maximum seed yield. These results are in conformity with the findings of Kahraman (2017[b]) in cowpea, Azarpour *et al.* (2011) in cowpea, Kahraman (2017[a]) in chickpea, Abhari & Gholinezhad (2019) in chickpea, Gayathri & Srinivasamurthy (2016) in maize and Reddy & Parama (2018) in turmeric.

The present investigation revealed that, RDF + foliar application of humic acid based bio- stimulant resulted in better plant growth and maximum seed yield in cowhage.

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