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Effect of biovita granules and liquid on growth and yield of cotton (*Gossypium hirsutum* L.)

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Abstract: A study was conducted on effect of biovita granules and liquid on growth and yield of cotton during *Kharif* 2014 and 2015 in deep black soil at ARS, Dhadesugr, University of Agricultural Sciences, Raichur, Karnataka. Pooled data revealed that, cotton yield and green biomass yield were significantly (p=0.05) higher in the treatment with the application of biovita granule at 12.5 kg per hectare at one month after sowing followed by first spray of biovita liquid at 500 ml per hectare at square formation followed by second spray of biovita liquid at 750 ml per hectare at flowering and followed by third spray of biovita liquid at 750 ml per hectare at boll formation (1450 kg/ha and 1463 g/plant, respectively) and which was on par with the application of biovita granule at 10.0 kg per hectare at one month after sowing followed by first spray of biovita liquid at 500 ml per hectare at square formation followed by second spray of biovita liquid at 750 ml per hectare at flowering and followed by third spray of biovita liquid at 750 ml per hectare at boll formation (1377 kg/ha and 1439 g/plant, respectively). Whereas, application of only recommended dose of fertilizer recorded significantly less cotton and green biomass yield compared to other treatments. The average per cent of increase in yield in biovita applied treatments (T_1 to T_8) over the no application of biovita treatment (T_9) was 7.13 %.

Keywords: Biovita, Bolls, Boll retention, Cotton yield, Economics

INTRODUCTION

Cotton is the most important fibre crop of India grown both under irrigated and rainfed conditions and has played a vital role in the agriculture based Indian economy. India is the third largest cotton producer in the world, occupying about 9 million hectares with a production of about 24.3 million bales in 2015-16. It accounts for 25 percent of world's total cotton area and 12 percent of global cotton production. However, the productivity of 448 kg ha^{-1} is still far lower than the world average of 718 kg ha^{-1}. The average yields in India are the lowest among the top 10 global cotton producers. There is a need to improve the yield and fibre quality of cotton. Various factors responsible for low productivity are non availability of quality seed of approved cultivars, unbalanced use of fertilizers, and deficiency of certain important micronutrients. Besides, shedding of reproductive parts like squares and young bolls are the common problems in cotton, which results in lower cotton yields. The use of certain growth regulators and micro-nutrients was found to be beneficial in increasing the seed yield and quality in cotton **(**Anon., 1995**).** Apart from major nutrients, the essential micronutrients like Boron and Magnesium play a vital role in certain physiological activities such as respiration, meristematic development, chlorophyll formation, photosynthesis, oil synthesis, gossypol and phenoloic compounds developments in cotton. Foliar applications of micronutrients have been widely studied (Karev, 1980, Khuzhanazarov *et al.,* 1983 and Eshanna *et al.,* 2004).

Biovita is an extract from a seaweed *Ascophyllum nodosum*-a marine plant that has been recognized as an excellent natural fertilizer and a rich source of organic matter. The manufacturer of Biovita M/S *PI Industries Ltd.,* claims that the application of Biovita enables plants to receive direct benefits from the naturally balanced nutrients and plant growth substances available in this seaweed extract. It is one of the most preferred products in its class as non-polluting, non-toxic natural bio-product. It provides over 60 naturally occurring major and minor nutrients and plant development substances comprising of enzymes, proteins, cytokinins, amioacids, vitamins, gibberlins, auxins, betains *etc*. in organic form. It contributes to greater microbial activity when applied to soil thus increasing nutrient availability. It is an ideal organic product for better growth and productivity. Moreover, it is compatible with insecticides, fungicides, and fertilizers, which can be used in combination, without additional cost of application. It is non corrosive and can be applied with any

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Table 1. Application of biovita granule and liquid on growth parameters of cotton.

Treatment	Germination % at 15 DAS			Plant height (cm)					
				60 DAS			120 DAS		
	2014	2015	Pooled	2014	2015	Pooled	2014	2015	Pooled
T_1	94.9	94.8	94.9	69.1	68.2	68.7	106	108	107
T_2	95.1	95.0	95.1	70.2	71.2	70.7	110	112	111
T_3	95.2	95.3	95.3	69.8	69.2	69.5	108	110	109
T_4	95.3	95.6	95.5	71.3	73.2	72.3	111	114	113
T_5	91.6	92.0	91.8	73.3	75.5	74.4	114	115	115
T_6	91.3	91.9	91.6	75.5	78.5	77.0	116	118	117
T_7	90.3	90.9	90.6	74.2	76.2	75.2	115	116	116
T_8	90.2	90.6	90.4	77.1	79.1	78.1	118	120	119
T_9	90.4	90.0	90.2	68.2	68.8	68.5	105	106	106
p=0.05	**2.72**	**2.31**	**2.52**	**5.68**	**7.27**	**3.64**	**9.04**	**8.30**	**5.11**

Table 2. Number of branches of cotton as influenced by the application of biovita.

Treatments	Branches per plant at 100 DAS					
	Monopodia			Sympodia		
	2014	2015	Pooled	2014	2015	Pooled
T_1	1.58	1.65	1.62	18.2	17.5	17.9
T_2	1.75	1.81	1.78	19.2	19.2	19.2
T_3	1.62	1.75	1.69	18.5	18.5	18.5
T_4	1.85	1.85	1.85	19.5	20.3	19.9
T_5	1.85	1.99	1.92	20.1	22.2	21.2
T_6	2.08	2.05	2.07	23.1	24.2	23.7
T_7	1.91	1.95	1.93	21.2	23.1	22.2
T_8	2.12	2.15	2.14	25.2	26.5	25.9
T_9	1.51	1.56	1.54	17.2	16.1	16.7
p=0.05	**0.26**	**0.20**	**0.11**	**4.60**	**2.10**	**2.21**

standard equipment. It has longer shelf life under normal room storage conditions. It can be applied at all stages of the plant growth from seeding to fruiting. The repeated use of Biovita contributes towards better root system, excellent appearance of plants and greater yield potential in cotton (Ramesh Kumar Gumber *et al.,* 2007). Keeping in view the above said properties of Biovita, attempts were made in the present investigation to study the effect of Biovita granules and liquid on growth and yield of cotton.

MATERIALS AND METHODS

A study was carried out at ARS, Dhadesugur, University of Agricultural Sciences, Raichur, Karnataka during *Kharif* 2014 and 2015 in deep black soil of uniform topography and texture with slightly alkaline pH (8.1), low in organic carbon (0.21%) and nitro-gen (160 kg/ha), medium in available phosphorus (26 kg/ha) and high in available potassium (486 kg/ha). The field experiment was laid out in a randomized block design with nine treatments and replicated thrice. The treatments consisted of biovita granule and liquid application *viz*., T1: Biovita granule followed by 2 sprays of biovita liquid (Biovita granule at 10 kg at the time of sowing followed by first spray of biovita liquid at 500 ml at square formation and followed by second spray of biovita liquid at 750 ml at flowering, T2: Biovita granule followed by 3 sprays of biovita liquid (Biovita granule at 10 kg at the time of sowing followed by first

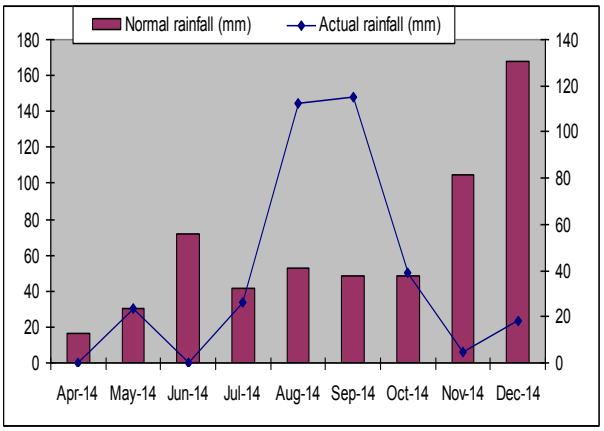

Fig. 1. *Monthly rainfall (mm) during Kharif 2014.*

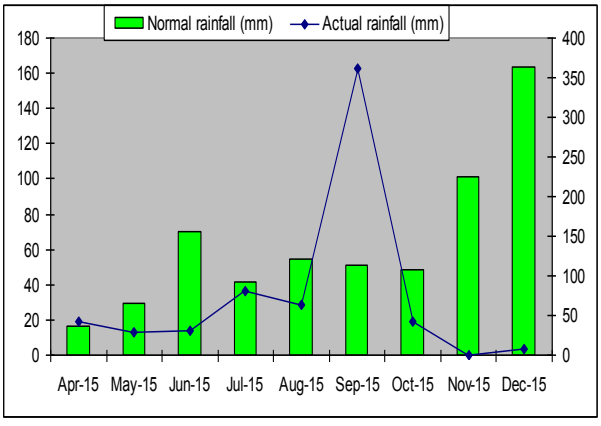

Fig. 2. *Monthly rainfall (mm) during Kharif 2015.*

Table 3. Squares and flowers of cotton as influenced by the application of biovita.

Treatment	Squares per plant at 60 DAS			Flowers per plant at 75 DAS		
	2014	2015	Pooled	2014	2015	Pooled
T_1	35.0	33.3	34.2	29.0	28.7	28.9
T_2	35.5	35.1	35.3	31.0	31.7	31.4
T_3	34.1	33.8	33.9	29.2	29.2	29.2
T_4	35.2	36.4	35.8	31.3	32.4	31.9
T_5	35.1	36.4	35.8	31.4	32.8	32.1
T_6	36.1	36.5	36.3	33.3	33.8	33.5
T_7	36.0	36.7	36.3	32.1	33.4	32.8
T_8	36.9	36.6	36.7	34.2	34.3	34.3
T_9	36.2	34.5	35.3	28.4	28.0	28.2
p=0.05	**NS**	**NS**	**NS**	**1.13**	**1.27**	**1.52**

Table 4. Bolls and its weight of cotton as influenced by the application of biovita.

Treatments	Bolls per plant at 110 DAS			Bolls weight (g) at 110 DAS		
	2014	2015	Pooled	2014	2015	Pooled
T_1	27.7	27.5	27.6	93.6	85.3	89.4
T_2	29.9	29.5	29.7	95.9	94.7	95.3
T_3	28.1	28.2	28.2	89.7	90.0	89.9
T_4	30.0	31.1	30.6	102.6	102.6	102.6
T_5	30.2	31.5	30.8	104.4	105.5	105.0
T_6	32.2	32.5	32.3	111.0	112.1	111.6
T_7	31.2	32.1	31.6	108.9	109.1	109.0
T_8	33.2	33.1	33.1	113.8	115.9	114.8
T_9	27.0	27.6	27.3	81.0	82.7	81.9
p=0.05	**1.25**	**1.16**	**1.56**	**5.86**	**5.29**	**4.25**

spray of biovita liquid at 500 ml at square formation followed by second spray of biovita liquid at 750 ml at flowering and followed by third spray of biovita liquid at 750 ml at boll formation), T3: Biovita granule followed by 2 sprays of biovita liquid (Biovita granule at 12.5 kg at the time of sowing followed by first spray of biovita liquid at 500 ml at square formation and followed by second spray of biovita liquid at 750 ml at flowering), T4: Biovita granule followed by 3 sprays of biovita liquid (Biovita granule at 12.5 kg at the time of sowing followed by first spray of biovita liquid at 500 ml at square formation followed by second spray of biovita liquid at 750 ml at flowering and followed by third spray of biovita liquid at 750 ml at boll formation), T5: Biovita granule followed by 2 sprays of biovita liquid (Biovita granule at 10 kg at one month after sowing followed by first spray of biovita liquid at 500 ml at square formation and followed by second spray of biovita liquid at 750 ml at flowering), T6: Biovita granule followed by 3 sprays of biovita liquid (Biovita granule at 10 kg at one month after sowing followed by first spray of biovita liquid at 500 ml at square formation followed by second spray of biovita liquid at 750 ml at flowering and followed by third spray of biovita liquid at 750 ml at boll formation), T7: Biovita granule followed by 2 sprays of biovita liquid (Biovita granule at 12.5 kg at one month after sowing followed by first spray of biovita liquid at 500 ml at square formation and followed by second spray of biovita liquid at 750 ml at flowering), T8: Biovita granule followed by 3 sprays of biovita liquid (Biovita granule at 12.5 kg at one month after sowing followed by first spray of biovita liquid at 500 ml at square formation followed by second spray of biovita liquid at 750 ml at flowering and followed by third spray of biovita liquid at 750 ml at boll formation) and T9: Control. Recommended dose of fertilizer (150:75:75 kg NPK/ha) was applied commonly for all the treatments. The gross plot size for each treatment was 6m x 4m = 24 m^2. Land was prepared well and cotton seeds (Ajith 155) were sown on last week of May month in both the years. Biovita granule and liquid was applied as per the treatments. Five plants were randomly selected in each plot of each replication and were tagged for the purpose of recording the observations *viz*., germination per cent at 15 days after sowing (DAS), plant height at 60 DAS, number of monopodia and sympodia branches at 100 DAS, number of flowers per plant at 75 DAS, number of bolls per plant at 110 DAS, weight of bolls per plant at 110 DAS, number of squares per plant at 60 DAS, Cotton yield (Seed+Lint), Boll retention per cent at 110 DAS and total biomass yield per plant at 120 DAS. Further, cotton yield from each net plot in each replication was harvested and weighed and recorded as cotton yield per net plot and this net plot yield was converted to yield per hectare. The cost of inputs that were prevailing at the time of their use was considered for working out the economics of various treatments. Net return per hectare was calculated by deducting the cost of cultivation from gross returns per hectare, gross returns was calculated by using the total income obtained from cotton yield and the benefit cost ratio was worked out as follows. Benefit cost ratio = Gross returns (`/ha)/Cost of cultivation (`/ ha). The

Table 5. Yield of cotton as influenced by the application of biovita granules and liquid.

Treatments	Boll retention % at 110 DAS			Cotton (Seed+Lint) yield (kg/ha)			Green biomass yield (g/plant) at 120 DAS		
	2014	2015	Pooled	2014	2015	Pooled	2014	2015	Pooled
T_1	79.7	82.5	81.1	1251	1255	1253	1311	1324	1318
T_2	84.5	84.2	84.4	1271	1271	1271	1325	1365	1345
T_3	84.5	84.2	84.4	1271	1271	1271	1325	1365	1345
T_4	85.2	85.5	85.4	1275	1275	1275	1351	1379	1365
T_5	86.2	86.5	86.4	1280	1286	1283	1372	1399	1386
T_6	89.2	88.9	89.0	1347	1407	1377	1425	1452	1439
T_7	86.7	87.6	87.1	1286	1295	1291	1392	1412	1402
T_8	90.0	90.5	90.3	1425	1474	1450	1456	1469	1463
T_9	75.0	80.2	77.6	1215	1225	1220	1214	1252	1233
p=0.05	**4.00**	**3.65**	**3.25**	**113.7**	**115.5**	**125.3**	**117.1**	**97.8**	**102.5**

Table 6. Economics of cotton as influenced by the application of biovita (Mean of 2014 and 2015).

Treatments	Cost of cultivation (`/ha)	Gross returns (`/ha)	Net returns (`/ha)	B:C ratio
T_1	26759	56385	29626	2.11
T_2	27115	57195	30080	2.11
T_3	26919	57195	30276	2.12
T_4	27275	57375	30100	2.10
T_5	26759	57735	30976	2.16
T_6	27115	61965	34850	2.29
T_7	26919	58095	31176	2.16
T_8	27275	65250	37975	2.39
T_9	25525	54900	29375	2.15
p=0.05	**NA**	**NA**	**5125.2**	**0.15**

Materials	Urea	DAP	MOP	Biovita granule	Biovita liquid	Cotton
Prices (Rs/kg)	5	20	15	64	475	45

data was analysed by statistically and tested significance of each treatment (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Effect of biovita on growth parameters of cotton: The pooled data on growth parameters of cotton as influenced by different rate of biovita granule and liquid application is presented in Tables 1 and 2. Results revealed that, Significantly higher germination per cent at 15 DAS was recorded in the treatment with the application of biovita granule at 12.5 and 10.0 kg per hectare at the time of sowing (T_1 to T_4) compared to other treatments (T_4 to T_9) where no application of biovita granules at the time of sowing. Biovita granule application was significantly influenced in improving the germination per cent in cotton. Similarly, application of biovita granule at 12.5 kg per hectare at one month after sowing followed by first spray of biovita liquid at 500 ml per hectare at square formation followed by second spray of biovita liquid at 750 ml per hectare at flowering and followed by third spray of biovita liquid at 750 ml per hectare at boll formation recorded significantly taller plants (78.1 and 119 cm at 60 and 120 DAS, respectively) and which was onpar with the application of biovita granule at 10.0 kg per hectare at one month after sowing followed by first spray of biovita liquid at 500 ml per hectare at square formation followed by second spray of biovita liquid at 750 ml per hectare at flowering followed by third spray of biovita liquid at 750 ml per hectare at boll formation (77 and 117 cm at 60 and 120 DAS, respectively) and application of biovita granule at 12.5 kg per hectare at one month after sowing followed by first spray of biovita liquid at 500 ml per hectare at square formation and followed by second spray of biovita liquid at 750 ml per hectare at flowering (75.2 and 116 cm at 60 and 120 DAS, respectively). Whereas, application of only recommended dose of fertilizer recorded significantly shorter plants (68.5 and 106 cm at 60 and 120 DAS, respectively) compared to other treatments. Further, monopodial and sympodial branches at 100 DAS were significantly higher in the treatment with the application of biovita granule at 12.5 kg per hectare at one month after sowing followed by first spray of biovita liquid at 500 ml per hectare at square formation followed by second spray of biovita liquid at 750 ml per hectare at flowering and followed by third spray of biovita liquid at 750 ml per hectare at boll formation (2.14 and 25.9, respectively) and which was onpar with the application of biovita granule at 10.0 kg per hectare at one month after sowing followed by first spray of biovita liquid at 500 ml per hectare at square formation followed by second spray of biovita liquid at 750 ml per hectare at flowering and followed by third spray of biovita liquid at 750 ml per hectare at boll formation (2.07 and 23.7, respectively) and application of biovita granule at 12.5 kg per hectare at one month after sowing followed by first spray of biovita liquid at 500 ml

per hectare at square formation and followed by second spray of biovita liquid at 750 ml per hectare at flowering (1.93 and 22.2, respectively). Whereas, application of only recommended dose of fertilizer recorded significantly least number of monopodia and sympodia branches (1.54 and 16.7, respectively) compared to other treatments.

Effect of biovita on yield parameters of cotton: Application of biovita granule and liquid was having greater influence on yield parameters of cotton. It increases the number of squares, flowers, bolls and boll retention per cent per plant in cotton **(**Tables 3, 4 and 5**)**. Application of biovita granule at 12.5 kg per hectare at one month after sowing followed by first spray of biovita liquid at 500 ml per hectare at square formation followed by second spray of biovita liquid at 750 ml per hectare at flowering and followed by third spray of biovita liquid at 750 ml per hectare at boll formation recorded significantly maximum flowers, bolls, boll weight and boll retention per cent (34.3 at 75 DAS, 33.1, 114.8 g and 90.3 % at 110 DAS, respectively) and which was onpar with the application of biovita granule at 10.0 kg per hectare at one month after sowing followed by first spray of biovita liquid at 500 ml per hectare at square formation followed by second spray of biovita liquid at 750 ml per hectare at flowering and followed by third spray of biovita liquid at 750 ml per hectare at boll formation (33.5 at 75 DAS, 32.5, 111.6 g and 89.0 % at 110 DAS, respectively) and application of biovita granule at 12.5 kg per hectare at one month after sowing followed by first spray of biovita liquid at 500 ml per hectare at square formation and followed by second spray of biovita liquid at 750 ml per hectare at flowering (32.8 at 75 DAS, 32.1, 109 g and 87.1 % at 110 DAS, respectively). Whereas, application of only recommended dose of fertilizer recorded significantly lower yield parameters compared to other treatments.

Effect of biovita on cotton (seed+lint) and green biomass yield: The pooled data on seed+lint and green biomass yield of cotton as influenced by different rate of biovita granule and liquid application is presented in Table 5. Cotton yield and green biomass yield were significantly higher in the treatment with the application of biovita granule at 12.5 kg per hectare at one month after sowing followed by first spray of biovita liquid at 500 ml per hectare at square formation followed by second spray of biovita liquid at 750 ml per hectare at flowering and followed by third spray of biovita liquid at 750 ml per hectare at boll formation (1450 kg/ha and 1463 g/plant, respectively) and which was onpar with the application of biovita granule at 10.0 kg per hectare at one month after sowing followed by first spray of biovita liquid at 500 ml per hectare at square formation followed by second spray of biovita liquid at 750 ml per hectare at flowering and followed by third spray of biovita liquid at 750 ml per hectare at boll formation (1377 kg/ha and 1439 g/plant, respectively). Whereas, application of only recommended dose of fertilizer recorded significantly least cotton and green biomass yield compared to other treatments. The average per cent of increase in yield in biovita applied treatments (T_1 to T_8) over the no application of biovita treatment (T_9) was 7.13 %. Mondino *et al.* (2004) reported that, application of growth regulators enhances the boll weight and boll number per plant in cotton. Plant growth regulators have the potential to promote crop earliness, square and boll retention, higher nutrient uptake, and keeping vegetative and reproductive growth in harmony to improve lint yield and quality **(**Robertson and Cothren, 1993 and Oosterhuis and Zhao, 1993).

Effect of biovita on economics of cotton: Obviously, application of biovita granule at 12.5 kg per hectare at the time of sowing followed by first spray of biovita liquid at 500 ml per hectare at square formation followed by second spray of biovita liquid at 750 ml per hectare at flowering and followed by third spray of biovita liquid at 750 ml per hectare at boll formation recorded higher cost of cultivation (27,275/ha) and gross returns (65,250/ha) compared to other treatments. Further, Net returns and B:C ratio were significantly higher in the treatment with the application of biovita granule at 12.5 kg per hectare at one month after sowing followed by first spray of biovita liquid at 500 ml per hectare at square formation followed by second spray of biovita liquid at 750 ml per hectare at flowering and followed by third spray of biovita liquid at 750 ml per hectare at boll formation (Rs.37,975/ha and 2.39, respectively) and which was onpar with the application of biovita granule at 10.0 kg per hectare at one month after sowing followed by first spray of biovita liquid at 500 ml per hectare at square formation followed by second spray of biovita liquid at 750 ml per hectare at flowering and followed by third spray of biovita liquid at 750 ml per hectare at boll formation (Rs.34,690/ha and 2.29, respectively) compared to other treatments (Table 6**).** Similar results also reported by Ramesh Kumar Gumber (2007) stated that application of biovita (growth regulators) enhance cotton yield and increases net returns in American cotton.

Conclusion

The study concluded that application of biovita granule at 12.5 or 10.0 kg per hectare at one month after sowing followed by first spray of biovita liquid at 500 ml per hectare at square formation followed by second spray of biovita liquid at 750 ml per hectare at flowering and followed by third spray of biovita liquid at 750 ml per hectare at boll formation was significantly increases the yield and yield parameters of cotton over the treatment with no application of biovita granules and liquid. Further, Biovita granule application significantly improved the germination per cent in cotton.

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