IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Effect Of Foliar Application Of Humic Substances On Yield Of *Bt*. Cotton

O.S.Rakhonde, Aniket Meshram, B.A.Sonune, S.U.Kakade, and A.V.Zope

Abstract

A field experiment was conducted during *kharif* 2021-22 at Research Farm, Cotton Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra. The eight treatments replicated three times in randomized block design comprised of chemical fertilizers alone and their combinations with foliar sprays of humic and fulvic acid with different concentrations at 45, 60 and 90 days after sowing.

The results indicated that application of recommended dose of N, P_2O_5 & K_2O + 1.5% Humic acid foliar spray were recorded significantly highest growth contributing character which was found at par with recommended dose of N, P_2O_5 & K_2O + 1% Humic acid foliar spray. Similarly, application of recommended dose of N,P_2O_5 & K_2O + 1.5% Humic acid foliar spray were recorded significantly highest seed cotton and cotton stalk yield which was found on par with recommended dose of N,P_2O_5 & K_2O + 1% Humic acid foliar spray.

Keywords- Humic acid, Fulvic acid and foliar application

Introduction

Cotton one of the principal crops in India and enjoys pride of place and unique position in our country. Cotton (*Gossypium sp.*) belongs to malvaceae family is oldest of all fibers used by human beings. It is known as a “King of fibers” crop due to its global importance in agriculture as well as industrial economy. It contributes significantly to both agriculture and industry in terms of farm income employment and export earnings. Cotton cultivation has traditionally concentrated in a few countries viz: China, United States, India, Pakistan, Brazil, Uzbekistan, Turkey and Australia. Together these countries account for more than three quarter of global production. At global level, cotton area is projected to grow by 9 percent and yield are only projected to increase by 6 percent. Cotton is commonly known as “White Gold” in farming community. Due to its multipurpose nature and use, it has huge demand from industry side, which makes this crop popular among the farming community.

Humic acid is one of the major components of humic substances. Humic matter is formed through the chemical and biological humification of plant and animal matter and through the biological activities of micro-organisms (Anonymous, 2010). The effects of humic substances on plant growth depend on the source and concentration, as well as on the molecular fraction weight of humus. Lower molecular size fraction easily reaches the plasma lemma of plant cells, determining a positive effect on plant growth, as well as a later effect at the level of plasma membrane, that is, the nutrient uptake, especially nitrate. It seems that humic substances may influence both respiration and photosynthesis (Nardi *et al.* 2002). Humic substances have a very strong influence on the growth of plant roots. The stimulatory effects of humic substances have been directly correlated with the enhanced uptake of macro-nutrients, such as nitrogen, phosphorus and sulfur (Chen and Aviad, 1990), and micronutrients, such as Fe, Zn, Cu and Mn (Chen *et al.* 1999).

Humic substances have been reported to influence plant growth both directly and indirectly. The indirect effects of humic compounds on soil fertility include: (i) Increase in the soil microbial population including beneficial microorganisms, (ii) Improved soil structure and (iii) Increase in the cation exchange capacity and the pH buffering capacity of the soil. Directly, humic acid compounds may have various biochemical effects either at cell wall, membrane level or in the cytoplasm, including increased photosynthesis and respiration rates in plants, enhanced protein synthesis and plant hormone-like activity (Chen and Aviad, 1990). Humic substances may possibly enhance the uptake of minerals through the stimulation of the microbiological activity (Mayhew, 2004).

Fulvic acid is a derivative of humic acid but it has smaller molecular size and is less stable in soil due to its greater exposure to microbial degradation. It occurs naturally in soil, water and peat like humic acids. Foliar application of humic acid improved the growth and development by improving photosynthesis (Fan *et al.* 2014). It induced the same effect of IAA in improving cell growth (Muscola *et al.* 2007). Fulvic acid has beneficial effects on plant growth, but the mechanism is still unclear (Silva *et al.* 2016).

MATERIAL AND METHODS

The present investigation was undertaken to study the effect of humic substances on yield of Bt cotton during 2021-22 at Cotton Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The soil of the experimental site was moderately alkaline in reaction, low in available nitrogen, medium in available phosphorus and high in potassium. The eight treatments replicated three times in randomized block design comprised of chemical fertilizers alone and their combinations with foliar sprays of humic and fulvic acid with different concentrations at 45, 60 and 90 days after sowing.The treatments comprised of absolute control, RDF control (60:30:30 $N:P_2O_5:K_2O$ kg ha^{-1}), RDF + 0.5% Humic acid foliar spray, RDF + 1% Humic acid foliar spray, RDF + 1.5% Humic acid foliar spray, RDF + 0.5% Fulvic acid foliar spray, RDF + 1% Fulvic acid foliar spray and RDF + 1.5% Fulvic acid foliar spray. Cotton field were kept under uniform management practices during the study, where all the cultural practices were carried out as per package of practices.

RESULT AND DISCUSSION

Growth and yield contributing character

The data pertaining to the plant height, bolls per plant and total chlorophyll content of cotton leaves at 60 and 90 DAS as influenced by different treatments presented in Table No.1 and 2.

Plant height

The data on plant height of cotton at harvest reported in Table 1, during the study. The results show progressive increase in height as influenced by various treatments. Cotton being a crop of indeterminate growth habit continued to grow till its final uprooting but *Bt* cotton has determinate growth habit. Due to favourable weather situations, good rainfall during early growth stages, which created improvement in vegetative growth of cotton crop.

The results clearly indicated that there was significant difference as influenced by different treatments. The maximum plant height (122.14 cm) was registered significantly with recommended dose of fertilizers along with 1.5% foliar spray of humic acid at 45, 60 and 90 days after sowing (T_5) which was on par with RDF + 1% foliar spray of humic acid (118.95 cm) (T_4) and RDF + 1.5% foliar spray of fulvic acid (118.86 cm) (T_8) at 45, 60 and 90 days after sowing. The lowest plant height was recorded in absolute control (T_1). The increased plant height could be accounted to the role of fertilizers, humic and fulvic acid in cell division and cell elongation. Schnitzer *et al*. (1972) reported that humic acid affect plant growth directly or indirectly. Basbag (2008) also reported the significant effect of humic acid applications on cotton plant height. The plant height was positive respond to different humic acid applications.

Table 1. Plant height and No. of bolls at harvest stage of cotton as influenced by different treatments

Tr. No	Treatment Details	Plant height (cm)	Bolls per plant
T1	Absolute control	91.67	9.28
T2	(RDF) control	114.92	23.54
T3	RDF + 0.5% Humic acid foliar spray	118.04	24.73
T4	RDF + 1% Humic acid foliar spray	118.95	25.10
T5	RDF + 1.5% Humic acid foliar spray	122.14	27.63
T6	RDF + 0.5% Fulvic acid foliar spray	116.51	23.89
T7	RDF + 1% Fulvic acid foliar spray	117.15	24.36
T8	RDF + 1.5% Fulvic acid foliar spray	118.86	25.60
	SE (m)±	1.22	1.07
	CD at 5 %	3.70	3.24

Bolls per plant at harvest stage of cotton

The data in respect of number of bolls per plant as influenced by different treatments presented in Table 1. Foliar application of humic and fulvic acid with different concentrations significantly influenced the number of bolls per plant at harvest. Application of RDF + 1.5% humic acid foliar spray recorded highest boll per plant (27.63) which was on par with RDF + 1.5% fulvic acid foliar spray, RDF + 1% humic acid foliar spray and RDF + 0.5% humic acid foliar spray. Tarhan *et al*. (2019) reported the improvement in cotton boll no. due to humic acid. Aydin *et al.* (1999) also reported that the humic acid application increased the vegetative production due to enhancing plants water and nutrition absorption capacity.

Chlorophyll index (SPAD reading)

The Chlorophyll index determines the photosynthetic capacity and influence the rate of photosynthesis, dry matter product and yield. It indicates physiological status of plant and is fundamentally essential pigment for conversion of light energy into chemical energy (Table 2).

Table 2. Total Chlorophyll index (SPAD readings) of cotton leaves as influenced by different treatments

Tr. No	Treatment Details	Total Chlorophyll index (SPAD readings)	
		60 DAS	**90 DAS**
T1	Absolute control	25.83	31.53
T2	(RDF) Control	28.23	35.87
T3	RDF + 0.5% Humic acid foliar spray	28.98	36.44
T4	RDF + 1% Humic acid foliar spray	29.05	39.28
T5	RDF + 1.5% Humic acid foliar spray	30.57	41.52
T6	RDF + 0.5% Fulvic acid foliar spray	28.84	36.18
T7	RDF + 1% Fulvic acid foliar spray	28.95	36.65
T8	RDF + 1.5% Fulvic acid foliar spray	28.98	38.10
	SE (m)±	0.53	1.54
	CD at 5 %	1.59	4.68

The manifestation of experimental data indicated that significant highest total chlorophyll index of cotton leaves at 60 DAS was recorded with the application of recommended dose of N, P_2O_5 & K_2O + 1.5 % humic acid foliar spray (30.57) which was found at par with recommended dose of N, P_2O_5 & K_2O + 1% humic acid foliar spray (29.05) which was followed by RDF + 1.5% Fulvic acid foliar spray, RDF + 1%

Fulvic acid foliar spray, RDF + 1% Humic acid foliar spray and RDF + 0.5 % Humic acid foliar spray.

The data in respect of total chlorophyll index of cotton leaves were recorded periodically at 90 DAS as influenced by different treatments presented in Table 6.

The application of recommended dose of N, P_2O_5 & K_2O + 1.5% Humic acid foliar spray was reported significantly maximum total chlorophyll index of cotton leaves (41.52) at 90 DAS as compared to rest of the treatments which was found at par with recommended dose of N, P_2O_5 & K_2O + 1% Humic acid foliar spray (39.28) and recommended dose of N,P_2O_5 & K_2O + 1.5% Fulvic acid foliar spray (38.10). Similar findings also reported by Anjum *et al.* (2011) and Meganid *et al.* (2015).

Seed cotton and cotton stalk yield

The data on seed cotton yield and stalk yield as influenced by various treatments are presented in Table 3. Significant highest yield was recorded with the application of recommended dose of N,P_2O_5 & K_2O + 1.5% Humic acid foliar spray (16.32 q ha^{-1}) which was found at par with the application of recommended dose of N,P_2O_5 & K_2O + 1% Humic acid foliar spray (15.81 q ha^{-1}). The lowest seed cotton yield was recorded in absolute control. The seed cotton yield increase with RDF + 1.5% Humic acid foliar spray (12.70 %), which was followed by RDF + 1% Humic acid foliar spray (9.19 %) over only application of RDF (T_2).

Perusal of data indicated that, the application of recommended dose of N, P_2O_5 & K_2O + 1.5% Humic acid foliar spray was recorded significantly highest cotton stalk yield (27.65 q ha^{-1}) which was found at par with recommended dose of N,P_2O_5 & K_2O + 1% Humic acid foliar spray (26.78 q ha^{-1}) and with recommended dose of N,P_2O_5 & K_2O + 1.5% fulvic acid foliar spray (26.54 q ha^{-1}). The lowest cotton stalk yield was recorded in absolute control (T1). Application of RDF along with humic and fulvic acid foliar spray resulted increase seed cotton and cotton stalk yield this might be due to enhancement of photosynthesis and enzymatic activity and also due to prevention of squares and shedding of bolls. These results indicated that humic acid application affected the lint turnout and seed cotton yield. This might be due to the increased chlorophyll content and enhanced rate of photosynthesis in response to the humic acid treatments.

Fertilizer has become necessary input to supply essential plant nutrients to get expected crop yields as soils are low in available N, P_2O_5 & K_2O content. Foliar spraying of humic substances play role in physiological and biochemical process in plants to achieve desirable results (Canellas and Olivares, 2014). Similar findings with results reported by Dhanasekaran (2011) and Seadh *et al.* (2012).

Table 3. Seed cotton and cotton stalk yield as influenced by various treatments

Tr. No.	Treatment Details	Yield (q ha^{-1})		Yield Increase over RDF (%)	
		Seed Cotton	Cotton Stalk	Seed Cotton	Cotton Stalk
T1	Absolute Control	5.13	11.42	--	--
T2	(RDF) Control	14.48	24.33	--	--
T3	RDF + 0.5% Humic acid foliar spray	15.42	25.98	6.49	6.78
T4	RDF + 1% Humic acid foliar spray	15.81	26.78	9.19	10.07
T5	RDF + 1.5% Humic acid foliar spray	16.32	27.65	12.70	13.65
T6	RDF + 0.5% Fulvic acid foliar spray	15.02	25.50	3.74	4.81
T7	RDF + 1% Fulvic acid foliar spray	15.30	25.84	5.65	6.21
T8	RDF + 1.5% Fulvic acid foliar spray	15.54	26.54	7.32	9.08
	SE (m)±	0.23	0.52	--	--
	CD at 5 %	0.70	1.59	--	--

CONCLUSION

Hence, it is concluded that, application recommended dose of fertilizers (60:30:30 N:P_2O_5:K_2O kg ha^{-1}) through chemical fertilizers along with humic acid foliar sprays @ 1.5% and 1% at 45, 60 and 90 days after sowing found beneficial for improving the growth parameters, seed cotton and cotton stalk yield and nutrient uptake in Inceptisols under rainfed condition.

REFERENCES

Anjum, S.A., L. Wang, M. Farooq, L. Xue and S. Ali, 2011. Fulvic acid application improves the Maize performance under well-watered and drought conditions. *Journal of Agronomy & Crop Science*., 197:409-417.

Anonymous, 2010. Humic and fulvic acids: The black gold of agriculture? (Available at http://www.humintech.com/pdf/humicfulvicacids.pdf)

Aydin, A., M. Turan and Y. Sezen, 1999. Effect of fulvic humic acid application on yield and nutrient uptake in sunflower and corn. *Improved Crop Quality by Nutrient Management,* pp.249-252.

Basbag, 2008. Effects of Humic Acid Application on Yield and Quality of Cotton (*Gossypium hirsutum L.*). *Asian Journal of Chemistry.* Vol. 20, No. 3: 1961-1966.

Canellas, L.P. and F.L. Olivares, 2014. Physiological responses to humic substances as plant growth promoter. *Chemical and Biological Technologies in Agriculture.,* 1(1):1-11.

Chen, Y. and T. Avaid, 1990. Effects of humic substances on plant growth. *American society of Agronomy and Soil sciences.* Madison.,161-186.

Chen, Y., C.E. Clapp, H. Magen and V.W. Cline, 1999. Stimulation of Plant Growth by Humic Substances. *Royal Society of Chemistry, Cambridge,* UK, pp. 255-263.

Dhanasekaran, K., 2011. Effect of lignite humic acid and NPK application on the yield and NPK uptake by cotton. *Green Farming.,* 2(5):618-620.

Fan, H., X. Wang, X. Sun, Y.Y. Li, X. Sun and C. Zheng, 2014. Effect of humic acid derived from sediments on growth, photosynthesis and chloroplast ultrastructure in chrysanthemum. *Scientia Horticulturae.,* 177:118-123.

Mayhew, L., 2004. Humic substances in biological agriculture. *ACRES USA.* A voice for Eco-Agriculture, 34(1-2), 8p.

Meganid, A.S., H.S. Al-Zahrani and M.S. El-Metwally, 2015. Effect of humic acid application on growth and chlorophyll contents of common bean plants (*Phaseolus vulgaris* L.) under salinity stress conditions. *International Journal of Innovative Research in Science, Engineering and Technology,* 4(5):2651-2660.

Muscola, A., M. Sidari, O. Franciosa, V. Tungnoli and S. Nardi, 2007. The Auxin like activity of humic substance is related to membrane interaction in carrot cell cultures. *Journal of Chemical Ecology.,* 33:115-129.

Nardi, S., D. Pizzeghello, A. Muscola and A. Vianello, 2002. Physiological effects of humic substances in higher plants. *Journal of Soil Biology and Biochemistry.,* 34:1527-1537.

Schnitzer, M., and S.U. Khan, 1972. Humic substances in the environment. New York.

Seadh, S.E., M.H. El -Hendi, H.A. Abd El- Aaland Shaimaa O.S. El- Sayed, 2012. Effect of NPK rates and humic acid application on growth of Egyptian cotton. *Journal of Plant Production.* 3(8): 2287-2299.

Silva, J.R., D.J. Silva, C.A.T. Gava, T.C. Oliveira and M.S.C. Freitas, 2016. Carbon in humic fractions of organic matter in soil treated with organic composts under mango cultivation. *Rev. Bras. Cienc. Solo.,*40.

Tarhan, M., and E. Karademir, 2019. Effect of different application methods of humic acid on cotton yield, plant growth and fiber quality. *CABI.,*22(4):537-546.