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Effect of Humic Substances on Germination and Growth of FCV Tobacco Seedlings in Karnataka Light Soil

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ABSTRACT: A nursery experiment was carried out during *kharif* seasons of 2018 and 2020 at Zonal Agricultural and Horticultural Research Station, Navile, Shivamogga to study the impact of humic substances on growth of FCV tobacco seedlings. The experiment was laid out in Randomized Complete Block Design with five treatments and four replications. The treatments consist of different methods and rates of humic substance application *viz.*, T_1: Soil application of humic substances @ 1.25 kg ha^{-1}, T_2: Soil application of humic substances @ 1.25 kg ha^{-1} + Foliar spray @ 0.05 % at 30 DAS, T_3: Soil application of humic substances @ 1.25 kg ha^{-1} + Foliar spray @ 0.05 % at 30 and 45 DAS, T_4: Soil application of humic substances @ 1.25 kg ha^{-1} + Foliar spray @ 0.05 % 10 days after reset to protray and T_5: Package of practices (Normal). The pooled data showed that the soil application of humic substances @ 1.25 kg ha^{-1} along with foliar spray @ 0.05 % at 30 and 45 days after sowing recorded significantly higher plant height (9.04 cm), number of leaves per seedling (4.73) and dry weight of seedlings (36.24 g per 10 seedlings) over package of practices (7.01 cm, 3.95 and 26.63 g, respectively). The study implies the vast scope for promoting the use of humic substances for the production of better seedlings with good seedling vigour in FCV tobacco.

Keywords: Humic substance, FCV tobacco, Foliar application, Soil application, Seedling vigour.

INTRODUCTION

Tobacco is one of the most important commercial crops in the world. It is feasible to cultivate in low-fertile and marginal areas because of its hardiness and resistance to drought. Among the various types of tobacco Flue Cured Virginia (FCV), Burley and Oriental types having significant export value and revenue generation. FCV tobacco with desirable chemistry and smoke parameters is an ideal choice for cigarette blends. FCV tobacco is largely grown as a rainfed crop in the Karnataka Light Soil (KLS) region under monsoon climatic conditions.

Tobacco seeds are very small and egg-shaped with thick seed-coat. They are about 0.75 mm long, 0.53 mm broad and 0.47 mm thick. In *Nicotiana tabacum* the average weight of the seed is 0.08 to 0.09 mg and there are 11,000-12,000 seeds per gram. The emerging seedlings are tiny and delicate and therefore, the seeds are unsuitable for sowing directly in the field. Hence, they are sown in small areas called nurseries or seed beds and tended carefully till the seedlings attain a particular size before transplanting in the main field. For successful raising of nurseries proper location, good preparation and manuring, adequate facilities for watering and timely controlling of pests and diseases are essential.

Humic substances are the resultant of biodegradation of plant tissues containing lignin and charcoal. It is made up of three major fractions: humic acid (soluble at acidic pH), fulvic acid (soluble at any pH) and humin (insoluble fraction). Soil humic compounds influence plant growth directly by promoting root systems and mineral nutrient uptake and indirectly by improving soil chemical and physical properties. Plant response to humic substances application depends upon the origin, concentration, method of application and stage of plant development. In addition, the effect of humic substances depends on plant species in terms of their developmental pattern such as germination rate, root elongation, shoot biomass and other physiological processes (Canellas and Olivares 2014).

Humic acid (HA) compounds are the most active components of soil organic matter and are formed and accumulated by animal and plant remains through the decomposition and production of humus by microbes through a series of geochemical processes. HA, when combined with various inorganic fertilizers, can

improve soil quality, increase fertilizer usage and increase crop yield and quality (Khan *et al.,* 2018). It can be sprayed directly onto plant foliage in liquid form or applied to soil as granules alone or as part of a fertilizer mixture. In some tobacco-growing places throughout the world, HA compounds are even utilized to lower soil alkalinity (Liqiong *et al.,* 2014).

Humic acid contains 51% to 57% C, 4% to 6% N and 0.2% to 1% P and other micronutrients in minute amounts. Application of 1.0 $kgha^{-1}$ to the soil can bring appreciable increase (up to 20%) in yields of cotton, sugar beet and groundnut and improvement in soil physico-chemical conditions. Application of such minute amounts of HA suggests its enzymatic characteristics. Treating seeds with HA may further increase its beneficial effects to enhance crop yield (He *et al.,* 2014). To take the advantage of the facts that HA offers great promise for agricultural utilization, this research study was initiated to evaluate different methods and rates of humic substance application on germination and seedling vigour in FCV tobacco nursery under KLS conditions.

MATERIAL AND METHODS

A nursery experiment was conducted at the Zonal Agricultural and Horticultural Research Station, Navile, Shivamogga during *Kharif* season of 2018 and 2020. The study site was located in the *Southern Transition Zone* (Zone-7) of Karnataka. The experiment consisted of five treatments and four replications and was laid out in a Randomized Complete Block Design. Treatment consists of different methods, time and rates of humic substances application *viz.,* T_1: Soil application of humic substances @ 1.25 kg ha^{-1}, T_2: Soil application of humic substances @ 1.25 kg ha^{-1} + Foliar spray @ 0.05 % at 30 DAS, T_3: Soil application of humic substances @ 1.25 kg ha^{-1} + Foliar spray @ 0.05 % at 30 and 45 DAS, T_4: Soil application of humic substances @ 1.25 kg ha^{-1} + Foliar spray @ 0.05 % 10 days after reset to protray and T_5: Package of practices (Normal). Humic substance used in the study was commonly available product from Grow well crops (Krushi Empire). It contains 95% of humic acid and fulvic acids.

Tobacco seedlings were raised in sandy soil with good internal as well as surface drainage. The site was used for sowing after soil solarization with transparent polyethylene film of 0.10 mm thickness for 45 days. Systematic layout of nursery on raised beds was done with intervening channels to help quick drainage of rain water. The beds were 1.0 m wide to facilitate hand-weeding and watering with rose cans. Seeds of the Kanchan variety were sown during the last week of May. The soil application of humic substances was done at the time of sowing by mixing with the farm yard manure. While foliar sprays were taken at 30 and 45 DAS as per the treatments. Resetting of seedlings was done to protrays at 30 DAS.

Biometric observations such as plant height and number of leaves $plant^{-1}$ were recorded day before transplanting (55 DAS) from ten seedlings and averaged. Dry weight of ten seedlings was recorded day before transplanting. Germination count was recorded in a fixed area of 100 cm^2 at 15 and 30 DAS during both years. Observations on damping off disease incidence (%) also recorded. The data recorded were analysed systematically by analysis of variance (ANOVA) using a standard procedure (Gomez and Gomez 1984).

RESULTS AND DISCUSSION

A. Effect of humic acid substances on germination of FCV tobacco seedlings

The soil application of humic substances (1.25 kg ha^{-1}) at the time of sowing has recorded higher germination count compared to non-application of humic substances in the control treatment. Ebrahimiand Miri (2016) showed that application of 30gl^{-1} humic acid was effective in germination of the plant species and stimulated the plants germination. The addition of humic substances to *Chlorophytum borivilianum* tubers had similar effects on germination (Nakasha *et al.,* 2014).

Table 1: Effect of humic acid substances on germination of FCV tobacco seedlings.

Treatments	Germination count (No./100 cm^2)					
	15 DAS			30 DAS		
	2018	2020	Pooled	2018	2020	Pooled
T_1: Soil application of humic substances @ 1.25 kg ha^{-1}	25.0	31.3	28.2	48.0	46.1	47.1
T_2: Soil application of humic substances @ 1.25 kg ha^{-1} + foliar spray @ 0.05 % at 30 DAS	24.0	30.5	27.2	51.0	54.9	52.9
T_3: Soil application of humic substances @ 1.25 kg ha^{-1} + foliar spray @ 0.05 % at 30 and 45 DAS	24.0	30.1	27.0	49.0	45.6	47.4
T_4: Soil application of humic substances @ 1.25 kg ha^{-1} + foliar spray @ 0.05 % 10 days after reset to protray	27.0	30.6	28.8	50.0	49.7	49.8
T_5: Recommended package of practices	23.0	24.0	23.5	43.0	52.1	47.5
S.Em.±	**0.97**	**1.30**	**0.98**	**2.16**	**3.24**	**2.21**
CD (p=0.05)	**NS**	**3.99**	**3.02**	**NS**	**NS**	**NS**

***DAS**-Days after sowing; **NS**- Non-significant

B. Effect of humic acid substances on growth parameters and disease incidence of FCV tobacco seedlings (Pooled)

Data about plant height (cm), number of leaves per plant, dry weight of seedlings (g) and damping off incidence (%) of FCV tobacco is furnished in Table 2. A significant difference was observed among the treatments due to the application of humic acid substances.

Analysis of pooled data revealed that soil application of humic substances at the rate of 1.25 kg per hectare along with foliar spray at the rate of 0.05 percent at 30 and 45 DAS (twice) resulted in significantly higher plant height (9.04 cm), which was found to be on par with treatments that received soil application of humic substances @ 1.25 kg ha^{-1} along with foliar spray @ 0.05% once at 30 DAS (8.75 cm) and treatment that received only soil application of humic substances at the rate of 1.25 kg per hectare (8.13 cm). Significantly lower plant height was recorded with the normal package of practices (7.01 cm). This might be due to the increased permeability of plant membranes and nutrient uptake with the application of humic substances, thereby achieving better plant growth and development. Moreover, HA might have also improved soil nutrient uptake by making mineral nutrients more mobile and available to plant root systems (Piccolo *et al*., 1992).

Higher number of leaves per plant (4.73) was obtained when the humic substance was applied to soil at the rate of 1.25 kg per hectare and as a foliar spray at a rate of 0.05 percent at 30 and 45 DAS. However, comparable results for the number of leaves $plant^{-1}$ were obtained with humic substances applied as soil application at the rate of 1.25 kg per hectare and as a foliar spray at the rate of 0.05 percent at 30 DAS (4.53) and with humic substances applied as soil application at the rate of 1.25 kg per hectare (4.45). With a typical package of practices, a considerable minimum number of leaves $plant^{-1}$ (3.95) was noted. These results are supported by the fact that red amaranth plants grown more on average when humic acid was applied, either through a foliage spray or a soil surface application. This was due to the plants' increased availability and absorption of macronutrient and micronutrient elements involved in cell metabolism, such as amino acid synthesis, chlorophyll synthesis and maintaining cell turgor, which support better plant growth (Lestari and Dewi 2020).

A perusal of pooled data indicated that statistically superior dry weight of seedlings (36.24 g per 10 seedlings) was observed in the plots that received application of humic substances by soil application at the rate of 1.25 kg ha^{-1} and foliar spray at the rate of 0.05 percent at 30 and 45 DAS and it was on par with the treatments that received soil application of humic substances at the rate of 1.25 kg ha^{-1} and foliar spray at the rate of 0.05 percent 10 days after reset to protray (34.06 g) and with the application of humic acid as both soil application at the rate of 1.25 kg ha^{-1} and as a foliar spray at the rate of 0.05 percent at 30 DAS (33.71 g). While least dry weight of seedlings was recorded with normal package of practices (26.63 g). Humic substances promote root and shoot development by increasing the surface area of the root which facilitates the water and nutrient uptake by the plants (Meganid *et al*., 2015). Fan *et al.* (2022) reported that the tobacco seedling rate, strong seedling index, biomass, plant height, stem diameter, leaf length and width increased first and then decreased with the increase of humic acid in the substrate and reached the maximum in the treatment of 1.0 to 1.5 g/plant and the seedling rate and the strong seedling index reached 92.3% and 1.05, increased by 3.6 percentage points and 16.7% compared with those of the control.

A numerically higher incidence of damping-off was recorded in the control treatment that received a recommended package of practices (17.8 %) and lower damping-off incidence was recorded with soil application of humic substances at the rate of 1.25 kg per hectare (13.7%). This result was in line with the results of the study by Fahri and Murat (2008), in which lower incidence of root rot and higher fresh weight of roots were recorded with the application of humic substances at the rate of 8 mg *a.i.*, per plant in tomato when compared to control. The decrease in root and stalk rots under the application of HA may be due to its effect in regulating hormone levels and enhancing the formation of antioxidants such as α-tocopherol, β-carotene, superoxide dismutase and ascorbic acid concentrations which play active roles in inducing disease resistance (Achuo *et al*., 2004).

Table 2: Effect of humic acid substances on growth parameters and damping off incidence in FCV tobacco seedlings.

Treatment	Plant height (cm)			Number of leaves $plant^{-1}$			Dry weight of seedlings (g / 10 seedlings)			Damping off incidence (%)		
	2018	2020	Pooled	2018	2020	Pooled	2018	2020	Pooled	2018	2020	Pooled
T_1: Soil application of humic substances @ 1.25 kg ha^{-1}	6.35	9.92	8.13	3.80	5.10	4.45	27.50	33.84	30.67	14.5	12.8	13.7
T_2: Soil application of humic substances @ 1.25 kg ha^{-1} + foliar spray @ 0.05 % at 30DAS	7.25	10.26	8.75	3.90	5.15	4.53	32.50	34.91	33.71	15.0	13.5	14.3
T_3: Soil application of humic substances @ 1.25 kg ha^{-1} + foliar spray @ 0.05 % at 30DAS and 45 DAS	7.46	10.62	9.04	4.70	4.75	4.73	34.00	38.48	36.24	17.5	15.4	16.5
T_4: Soil application of humic substances @ 1.25 kg ha^{-1} + foliar spray @ 0.05 % 10 days after resetting to protray	6.55	7.85	7.20	4.10	4.10	4.10	30.00	38.12	34.06	15.5	14.2	14.9
T_5: Package of practices	5.89	8.12	7.01	3.7	4.20	3.95	24.75	28.50	26.63	18.0	17.6	17.8
S.Em.±	**0.24**	**0.52**	**0.31**	**0.20**	**0.27**	**0.16**	**1.62**	**2.17**	**1.30**	-	-	-
CD (p=0.05)	**0.74**	**1.60**	**0.97**	**0.61**	**0.83**	**0.50**	**5.00**	**6.69**	**3.99**	-	-	-

CONCLUSIONS

The two-year study concluded that the application of humic substance in FCV tobacco as soil (at 1.25 kg ha^{-1}) and foliar supplementation (at 0.05%) at 30 DAS and 45 DAS helps to increase plant height (cm), number of leaves per plant, dry weight of FCV tobacco seedlings and reduce damping off disease incidence in FCV tobacco nursery. The application of these humic substances also accelerated seed germination by breaking seed dormancy. As a result, soil application of humic substance at seed sowing, followed by foliar application at 30 and 40 DAS in FCV tobacco nursery, can be promoted as an environmentally friendly good agronomic practice to achieve quality seedling production for improved field establishment and crop productivity in Karnataka light soil.

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Conflict of Interest. None.

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