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EFFECT OF FOLIAR SPRAY OF Zn, Mg AND TOPPING LEVELS ON YIELD AND QUALITY OF FCV TOBACCO CV. KANCHAN IN NORTHERN LIGHT SOILS (ALFISOLS) OF ANDHRA PRADESH

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Field experiment was conducted for two consecutive seasons (2004-05 and 2005-06) to study the influence of foliar spray and topping level on yield and quality of FCV tobacco cv. Kanchan proved that two foliar sprays of 0.5% Zn SO_4 + 0.5% Mg SO_4 at 35 and 45 days after planting enhanced mean green leaf yield, cured leaf yield and grade index by 2303.5 (15.7%), 116 (5.1%) and 236.5 kg/ha (14.77%) respectively as compared to two water sprays. Topping at 24 and 28 leaves both being on a par enhanced mean green leaf yield by 2649 (18.6%) and 2701 kg/ha (19.0%), cured leaf yield by 500 (24.8%) and 529 kg/ha (26.3%), and that of grade index by 489 (35.1%) and 519 kg/ha (37.2%), respectively as compared to 16 leaves topping level. Foliar sprays of 0.5% Zn SO_4 + 0.5% Mg SO_4 recorded significantly higher reducing sugars in P and X positions in both the seasons and higher nicotine in P, X, L and T positions during 2004-05 and in P and X positions only during 2005-06 as compared to other foliar sprays. Topping at 28 leaves level recorded significantly lower reducing sugars and nicotine content and there was a significant increase in reducing sugars and nicotine content as the topping level decreased from 28 to 16 leaves. Chlorides were well within the acceptable limits of good quality. It can be concluded that two foliar sprays of $ZnSO_4$ + Mg SO_4 at 35 and 45 days after planting and topping at 24 or 28 leaves would be optimum for the cv. Kanchan for getting higher green leaf yield, cured leaf yield and grade index with superior quality in irrigated Alfisols of Andhra Pradesh.

INTRODUCTION

FCV tobacco variety Kanchan is a high yielding (22-25 q/ha) variety occupying more than 95% of the area in Northern Light Soils. It is a well known fact that leaf yield primarily depends on the genotype and secondly by the proper production practices. A variety can be improved to show its maximum potential by improved agro-practices. This high yielding cv. Kanchan is fertilized with the major nutrients N, P and K only. Presently, no micronutrient fertilizers are applied to this crop. Though required in small quantity, micronutrients are equally important for successful crop production. Continuous cultivation of tobacco in these soils without applying the micronutrient fertilizers might have resulted in the depletion of these nutrients due to continuous removal by different crops. Moreover the variety cultivated previously was 16/103 which was a low yielder (12-15 q/ha) compared to the present cultivars. Sandy soils are low in Mg content and response to Mg SO_4 spray was noticed in earlier experiments. Zn is also one of the important trace elements involved in auxin (IAA) production and essential for protein synthesis. Studies on INM conducted at CTRI RS, Jeelugumilli with this variety also showed significant increase in grade index due to foliar spray of Zn and Mg though there was no significant increase in cured leaf yield (Krishna Reddy *et al.*, 2005). Topping of tobacco not only increases the yield but also improves the quality of cured leaf. Keeping these observations in view, the present investigation was designed to study the influence of Zn and Mg foliar spray and the effect of topping level on yield and quality of cv. Kanchan in irrigated Alfisols of Andhra Pradesh.

MATERIALS AND METHODS

Field experiments were conducted at the Central Tobacco Research Institute Research Station, Jeelugumilli for two consecutive seasons during 2004-05 and 2005-06 to study the influence of Zn and Mg foliar spray and the effect of topping level on yield and quality of cv. Kanchan in irrigated Alfisols. The experimental soil is slightly acidic in reaction (pH: 6.1-6.3) with low soluble salts (0.17-0.26 dS/m), chlorides (20 –28 ppm) and nitrogen (118-129 kg/ha), low to medium with respect to P (22-25 kg/ha) and K (75-80 kg/ha) in surface layers. The surface layer

(0-9") texture is loamy sand to sandy loam and deeper layers are sandy clay. The experiment was laid out in a Factorial Randomized Block Design (FRBD) replicated three times with four treatments on foliar sprays {(1) Water spray at 35 and 45 days after planting (DAP), (2) 0.5% Zn SO_4 spray at 35 and 45 DAP, (3) 0.5% Mg SO_4 spray at 35 and 45 DAP and (4) 0.5% Zn SO_4 + 0.5% Mg SO_4 spray at 35 and 45 DAP} and four topping levels (16 leaves, 20 leaves, 24 leaves and 28 leaves). Sunnhemp seed @ 50 kg/ha was sown in the first week of July and *in situ* incorporation was done before flowering at 50-55 days crop stage in first week of September depending upon the monsoon rains. It was seen that there is a minimum of 30 days time interval between sunnhemp *in situ* incorporation and tobacco planting. The gross plot size was 6 x 6 m (60 plants) and the net plot size was 4 x 4.8 m (32 plants) with spacing of 100 x 60 cm. Tobacco seedlings of 60 days old were planted in the first week of October in both the years. Nitrogen @ 115 kg/ha and potassium @ 120 kg/ha were applied in three splits in 1:2:1 proportions at 7-10 DAP, 25-30 DAP and 40-45 DAP. Phosphorus was applied @ 60 kg P_2O_5/ha In basal dose, first split of N and full dose of P in the form of di-ammonium phosphate and K_2O in the form of potassium sulphate were applied 10 DAP. In top dressing second and third splits of N and K were applied through CAN and potassium sulphate at 25-30 days after planting and 40-45 DAP. All the fertilizers were applied in dollop method at 10 cm away and at a depth of 10 cm on either side of the plant by making holes by either sticks (*Gasika*) or spades. Foliar sprays as per treatment were given at 35 and 45 DAP.

Recommended cultural practices were followed for raising the crop. The crop was topped at 16, 20, 24 and 28 leaves as per the treatment at bud stage. Decanol 4% was applied @ 10-15 ml/plant for preventing the sucker growth immediately after topping. At later stages, suckers were removed through manual desuckering. The first priming was done 90 DAP. Mature green leaves were harvested by priming and cured in the barn.

The data of green leaf and cured leaf were recorded and grade index was calculated. The cured leaf samples collected from P, X, L and T positions (2004-05 and 2005-06) were analysed for sugars, nicotine and chlorides as per standard methods. The data were statistically analysed .

RESULTS AND DISCUSSION

Yield characters

Foliar spray: Data on yield characters of tobacco are presented in Table 1. There were significant differences among the treatments with regard to green leaf yield, grade index, green leaf/cured leaf ratio and grade index/cured leaf (%). Green leaf yield with two foliar sprays of 0.5% Zn SO_4 + 0.5% Mg SO_4 at 35 and 45 DAP being on a par with 0.5% Mg SO_4 sprays was significantly higher than water spray and 0.5% Zn SO_4 spray during both the years and in pooled data. The green leaf yield increased by 15.15 and 16.30% with two foliar sprays of 0.5% Zn SO_4 + 0.5% Mg SO_4 and 10.01 and 10.85% with two foliar sprays of Mg SO_4 as compared to water sprays during 2004-05 and 2005-06 seasons, respectively.

There were no significant differences between the treatments with regard to cured leaf yield with micronutrient foliar spray in both the years and in pooled data. Though the differences were not significant, cured leaf yield was increased by 4.64 and 5.55% with two foliar sprays of 0.5% Zn SO_4 + 0.5% Mg SO_4 as compared to water sprays during 2004-05 and 2005-06 seasons, respectively. Grade index with two foliar sprays of 0.5% Zn SO_4 + 0.5% Mg SO_4 at 35 and 45 DAP being on a par with 0.5% Zn SO_4 sprays was significantly higher than water spray and 0.5% Mg SO_4 spray. The grade index increased by 14.30 and 15.28% with two foliar sprays of 0.5% Zn SO_4 + 0.5% Mg SO_4 and 9.23 and 10.16% with two foliar sprays of 0.5% Zn SO_4 as compared to water sprays during 2004-05 and 2005-06 seasons, respectively. Green leaf/cured leaf ratio was significantly higher with two foliar sprays of 0.5% Zn SO_4 + 0.5% Mg SO_4 when compared to other foliar spray treatments and followed the order of 0.5% Mg SO_4 > 0.5% Zn SO_4 > water sprays. Grade index/cured leaf (%) was significantly higher with two foliar sprays of 0.5% Zn SO_4 + 0.5% Mg SO_4 when compared

Table 1: Effect of foliar spray of Zn and Mg and level of topping on yield and quality of FCV tobacco (cv. Kanchan) in irrigated Alfisols of AP (2004-06)

Treatments	Tobacco leaf yield (kg/ha)														
	Green leaf			Cured leaf			Grade index			Green leaf / cured leaf			Grade index/ cured leaf		
	04-05	05-06	Mean	04-05	05-06	Mean	04-05	05-06	Mean	04-05	05-06	Mean	04-05	05-06	Mean
Foliar spray															
Water spray at 35 and 45 DAP	15077	14253	14665	2327	2236	2281	1657	1545	1601	6.49	6.39	6.44	71.0	68.9	70.0
0.5% Zn SO_4 spray at 35 and 45 DAP	16288	15537	15912	2403	2325	2364	1810	1702	1756	6.79	6.69	6.74	75.2	73.0	74.1
0.5% Mg SO_4 spray at 35 and 45 DAP	16587	15799	16193	2374	2295	2334	1741	1637	1689	7.00	6.90	6.95	73.2	71.1	72.1
0.5% $ZnSO_4$ + 0.5% $MgSO_4$ spray at 35 and 45 DAP	17361	16576	16968	2435	2360	2397	1894	1781	1837	7.14	7.04	7.09	77.6	75.5	76.5
SEm±	**289**	**320**	**216**	**41.66**	**43.89**	**30.26**	**32.19**	**33.48**	**23.22**	**0.02**	**0.03**	**0.02**	**0.30**	**0.28**	**0.18**
CD (P=0.05)	**834**	**925**	**598**	**NS**	**NS**	**NS**	**92.97**	**96.67**	**64.37**	**0.07**	**0.08**	**0.05**	**0.81**	**0.82**	**0.56**
Topping level															
16 leaves	14646	13802	14224	2059	1968	2014	1450	1340	1395	7.11	7.00	7.06	70.4	68.3	69.3
20 leaves	16138	15295	15716	2353	2262	2307	1749	1634	1691	6.86	6.76	6.81	74.3	72.2	73.2
24 leaves	17240	16506	16873	2548	2479	2513	1936	1832	1889	6.76	6.65	6.71	76.0	73.9	75.0
28 leaves	17287	16562	16925	2578	2507	2542	1968	1859	1913	6.70	6.60	6.65	76.3	74.1	75.2
SEm±	**289**	**320**	**216**	**41.66**	**43.89**	**30.26**	**32.19**	**33.48**	**23.22**	**0.02**	**0.03**	**0.02**	**0.30**	**0.28**	**0.18**
CD (P=0.05)	**834**	**925**	**598**	**120**	**126.7**	**83.87**	**93**	**96.67**	**64.37**	**0.07**	**0.08**	**0.05**	**0.81**	**0.82**	**0.54**
Seasons															
2004-05			16328			2385			1776			6.86			74.2
2005-06			15541			2304			1666			6.76			72.1
SEm±			**207**			**25.4**			**21.1**			**0.03**			**0.03**
CD (P=0.05)			**814**			**NS**			**82.7**			**0.11**			**0.10**

to other foliar spray treatments and was in the order of 0.5% Zn SO_4 > 0.5% Mg SO_4 > water sprays.

The increase in green leaf yield, cured leaf yield and grade index with Zn SO_4 + Mg SO_4 sprays as compared to water sprays might be due to the fact that the cv. Kanchan is a high yielding variety and it requires higher amounts of nutrients for expressing its full yield potential. In this study two foliar sprays of Zn SO_4 + Mg SO_4 at 35 and 45 DAP might have supplied required quantum of nutrients for proper growth and development of the crop thus producing higher yield and better quality in terms of grade index. Mg is involved as the central atom of the chlorophyll molecule and a small portion of the total Mg is bound to chlorophyll. Mg also has an essential function as a bridging element for aggregation of ribosome subunits, a process that is necessary for protein synthesis (Marshner, 1986).

The beneficial effect of Zinc due might be to production of proteins and auxins (IAA) resulting in better development of growth attributes. The improvement in plant growth consequently resulted in greater rate of photosynthesis leading to betterment of yield attributes which led to higher biomass production inturn green leaf yield, cured leaf yield and grade index probably owing to influence of Zn application on protein and auxin synthesis (Marshner, 1986). Krishna Reddy *et al.* (2005) reported the increase in growth attributes and yield by Zn application in FCV tobacco.

Topping level: The topping levels significantly differed among themselves, with regard to green leaf yield, cured leaf yield, grade index, green leaf/ cured leaf ratio and grade index/cured leaf (%) during both the seasons. Green leaf yield at 28 and 24 leaves topping levels being on a par was significantly higher than at 16 and 20 leaves topping levels during 2004-05 and 2005-2006. Green leaf yield at 28 and 24 leaves topping level was 18.03 and 15.05% more when compared with 16 leaves topping level during 2004-05 and was 20.0 and 19.59% more when compared with 16 leaves topping level during 2005-06 seasons, respectively. Cured leaf yield at 28 and 24 leaves topping levels being on a par was significantly higher than at 16 and 20 leaves topping levels during both the years. Cured leaf yield at 28 leaves and 24 leaves topping level was 25.20 and 23.75% more when compared with 16 leaves topping level during 2004-05 and was 27.38 and 25.97% more when compared with 16 leaves topping level during 2005-06, respectively. Grade index at 28 leaves topping being on a par with 24 leaves topping was significantly higher than at 16 and 20 leaves topping level in 2004-05 and 2005-06. Grade index at 28 and 24 leaves topping level was 35.72 and 33.52% more when compared with 16 leaves level of topping during 2004-05 and was 38.73 and 36.72% more when compared with 16 leaves level of topping during 2005-06, respectively. Greenleaf/ cured leaf ratio was significantly more with 16 leaves topping level and was in the order of 20 leaves topping >24 leaves topping > 28 leaves topping. Grade index/ cured leaf (%) at 28 leaves topping being on par with 24 leaves topping was significantly higher than at 16 and 20 leaves topping level. These results are in agreement with the findings of Suryanarayana Reddy *et al.* (1997) that topping at higher level resulted in significantly higher cured leaf, bright leaf yield and TBLE (total bright leaf equivalent) as compared to low level of topping. King (1986), Kasturi Krishna *et al.* (2004) and Krishna Reddy *et al.*, (2003) also reported yield increase with increase in topping level. Collins and Hawks Jr. (1993) also reported that within a given row width and spacing within a row, as plants were topped with fewer leaves, the yield was lowered.

Quality characters

Data on reducing sugars, nicotine, reducing sugars/nicotine and chlorides are presented in Table 2. The differences for quality parameters among the foliar sprays were significant for reducing sugars in P and X position, for nicotine in P, X and L positions and for RS/nicotine in all positions. In general reducing sugars (%) increased from P to X position and decreased in L & T position. Nicotine content increased from P to T position. Reducing sugars/nicotine increased from P to X position and decreased from X to T position. Reducing sugars/nicotine was lower than the expected due to seasonal influence.

Table 2: Effect of foliar spray of Zn and Mg and level of topping on chemical quality characters of FCV tobacco (cv. Kanchan) in irrigated Alfisols of AP (pooled)

Treatments	Nicotine (%)				Reducing sugars (%)				Reducing sugars/ Nicotine				Chlorides (%)			
Foliar spray	P	X	L	T	P	X	L	T	P	X	L	T	P	X	L	T
Water spray	1.65	1.88	2.75	3.08	10.44	12.69	11.06	6.85	6.31	6.60	4.03	2.23	0.46	0.45	0.55	0.54
0.5% Zn SO_4 spray	1.58	1.94	2.77	3.05	11.26	13.78	11.20	6.75	6.98	6.97	4.02	2.22	0.51	0.46	0.52	0.54
0.5% Mg SO_4 spray	1.62	1.77	2.76	3.03	11.28	13.31	11.09	6.69	6.98	7.40	4.00	2.21	0.50	0.49	0.58	0.61
0.5% $ZnSO_4$ + 0.5% $MgSO_4$ spray	1.76	2.01	2.90	3.12	12.21	14.34	11.53	6.97	6.90	7.00	3.97	2.24	0.43	0.42	0.5	0.56
SEm±	**0.02**	**0.03**	**0.03**	**0.03**	**0.22**	**0.23**	**0.24**	**0.11**	**0.06**	**0.05**	**0.05**	**0.03**	**0.02**	**0.01**	**0.01**	**0.01**
CD (P=0.05)	**0.06**	**0.07**	**0.09**	**NS**	**0.62**	**0.64**	**NS**	**NS**	**0.15**	**0.14**	**NS**	**NS**	**0.05**	**0.04**	**0.04**	**0.04**
Topping level																
16 leaves	1.78	2.03	3.03	3.32	12.94	15.20	12.41	7.37	7.20	7.31	4.09	2.22	0.50	0.48	0.58	0.62
20 leaves	1.69	1.94	2.86	3.14	11.78	14.06	11.62	6.99	6.94	7.09	4.04	2.23	0.51	0.46	0.55	0.59
24 leaves	1.61	1.86	2.73	2.99	10.67	12.90	10.83	6.62	6.58	6.83	4.00	2.22	0.46	0.45	0.52	0.55
28 leaves	1.54	1.77	2.57	2.84	9.81	11.96	10.01	6.27	6.36	6.68	3.89	2.22	0.44	0.43	0.50	0.50
SEm±	**0.02**	**0.03**	**0.03**	**0.03**	**0.22**	**0.23**	**0.24**	**0.11**	**0.06**	**0.05**	**0.05**	**0.03**	**0.02**	**0.01**	**0.01**	**0.01**
CD (P=0.05)	**0.06**	**0.07**	**0.09**	**0.09**	**0.62**	**0.64**	**0.67**	**0.30**	**0.14**	**0.14**	**.14**	**NS**	**0.05**	**NS**	**0.04**	**0.04**
Seasons																
2004-05	1.63	1.79	2.63	2.96	6.43	8.73	9.57	6.82	3.95	4.89	3.63	2.30	0.70	0.65	0.70	0.72
2005-06	1.67	2.02	2.96	3.18	16.16	18.33	12.87	6.81	9.64	9.06	4.35	2.13	0.25	0.26	0.37	0.41
SEm±	**0.02**	**0.03**	**0.01**	**0.02**	**0.10**	**0.23**	**0.15**	**0.06**	**0.03**	**0.03**	**0.04**	**0.03**	**0.01**	**0.01**	**0.01**	**0.01**
CD (P=0.05)	**NS**	**0.13**	**0.04**	**0.08**	**0.38**	**0.90**	**0.60**	**NS**	**0.13**	**0.13**	**0.15**	**NS**	**0.03**	**0.04**	**0.04**	**0.03**
Acceptable limits	0.7-3.5				8.0-24.0				6.0-13.0						<1.5	

P = Primings (first and second harvest from bottom), X = Lugs and cutters (third and fourth harvest), L = Leaf (fifth to 10^{th} harvest) and T= Tips (11^{th} and 12^{th} harvest) @ two leaves per harvest.

Reducing sugars and nicotine contents were significantly higher in P and X position with two foliar sprays of 0.5% Zn SO_4 + 0.5% Mg SO_4 at 35 and 45 DAP as compared to other foliar spray treatments. Lower level of topping (16 and 20 leaves) showed higher nicotine and reducing sugars and lower RS/nicotine than higher level of 24 and 26 leaves topping (Kasturi Krishna *et al.*, 2004). Chlorides were well within the acceptable limits in all the treatments. Lower topping significantly increases the concentration of nicotine in leaves and the earlier the plants are topped, greater the increase (Marshall and Seltzmann, 1964: Krishna Reddy *et al.*, 2003). Leaves from topped plants have a higher concentration of starch than untopped plants, which results in an increased reducing sugar concentration in the cured leaves (Crafts - Brandner, 1991). Interaction effects between foliar spray and topping level were not significant with regard to green leaf, cured leaf, grade index and also for quality parameters.

It is to conclude that two foliar sprays of 0.5% $ZnSO_4$ + 0.5% $MgSO_4$ at 35 and 45 DAP and topping at 24 or 28 leaves would be optimum for the cv. Kanchan for getting higher green leaf yield, cured leaf yield and grade index with superior quality in irrigated Alfisols of Andhra Pradesh.

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