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INFLUENCES OF VARYING PROPORTION OF UREA AND AMMONIUM SULPHATE ON YIELD AND CHEMICAL COMPOSITION OF RUSTICA TOBACCO (*NICOTIANA RUSTICA* L.) AS WELL AS CHEMICAL PROPERTIES OF SOIL

S. C. PARMAR*, S. V. RATHOD, S. M. GONDALIYA AND N. N. CHAUDHARY
Department of Agricultural Chemistry & Soil Science,
B. A. College of Agriculture, Anand Agricultural University, Anand - 388 110
e-mail: scp567@gmail.com

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***Corresponding author**

ABSTRACT

The present investigation was carried out to find out ideal proportion of urea and Amonium sulphate for the application of 200 kg N ha^{-1} and thereby different levels of S on yield, quality and chemical composition of *rustica* tobacco variety GC-1 and related soil properties in middle Gujarat condition. There are six treatments where comprised with four replications applied as urea and AS as follow: T_1 100:80, T_2 80:20, T_3 60:40, T_4 40:60, T_5 20:80 and T_6 00:100. The thickness of the leaf (30.75 mg/cm^2) was significantly higher due to T_2. The yield (3203 kg ha^{-1}) was significantly higher with T_2 treatment which was at par with T_1 while the quality parameters found non-significant. The N, K and S contents were increased up to 3.73, 0.80 and 0.68 % respectively in T_5 while P content increased about 0.65 % in T_1 treatments. The uptakes of all these macronutrients were significantly higher with T_2 and found at par with T_1 and T_3. The Mn, Zn and Cu content of the leaf was about 232.0, 53.0 and 35.0 ppm respectively which was significantly higher with T_6. The available P_2O_5 and S contents of the soil were significantly influenced by different treatments.

INTRODUCTION

Especially in tobacco fertilizers, sulphur is found in greater proportion then other fertilizer mixtures mainly because of low amount of chloride recommended for tobacco mixtures (Elliot, 1975). Even bidi tobacco grown in Gujarat is fertilized with recommended sources of nitrogen through ammonium sulphate (Patel and Patel, 1962). But looking to the huge price and non availability of the ammonium sulphate as well as toxicity of sulphur to tobacco crop the recommended dose for fertilizer application was modified for bidi tobacco. Therefore bidi tobacco is fertilized with 200 kg ha^{-1} nitrogen in the proportion of 75:25 of urea and ammonium sulphate (Patel *et al*., 2004) but the farmers of middle Gujarat are not maintaining the ratio of urea and ammonium sulphate as urea is the cheapest source of nitrogen and non availability of ammonium sulphate at the time of transplanting of tobacco. It directly influenced the yield and quality of tobacco as urea is 8 percent less efficient as compare to ammonium sulphate (Patel and Patel, 1978).

Among different states, Gujarat ranks second in area (1.48 lakh hectares), production (2.81 lakh tonne) and average productivity (1899 kg ha^{-1}) (Anon., 2012). Among different types of tobacco grown in Gujarat, Bidi tobacco occupies 81 %, chewing (*Lal chopadia, Kala chopadia* and *Rustica*) 18 % and *Gadaku (Hookah)* 0.5 to 1.0 % area. Its cultivation is mainly concentrated in light textured soils of Mahesana, Banaskantha and Sabarkantha districts in north Gujarat and Petlad, Borsad, Khambhat and Nadiad talukas of Anand and Kheda districts in middle Gujarat. On an average about 37 percent of soil samples collected from all over the Gujarat state were deficient in available sulphur and the magnitude was higher in light soils of north and middle Gujarat (Kalyansundaram and Patel, 1998). Sulphur deficiency in crop plants are becoming wide spread on account of use of high analysis fertilizers which contain little or no sulphur. Kumar *et al*. (2014) and Pal *et al*. (2015) noticed positive response in yield and nutrients of rice and tomato crop when various source of nutrient was applied to the soil, respectively. However the sulphur requirement of rustica tobacco has not been studied. Therefore present study is undertaken with different proportions of urea and ammonium sulphate to find out the most economical proportion of urea and ammonium sulphate to meet the requirement of nitrogen and sulphur with affecting the yield and quality of rustica tobacco as well as fertility status of the soil.

MATERIALS AND METHODS

The experimental soil was texturally loamy sand which was deep, well drained and has fairly high moisture retentive capacity. It has negligible soluble salt content (EC: 0.15 dSm^{-1}) and slightly alkaline (pH:7.8) in nature with poor organic matter (0.35 %), low N (188.2 kg ha^{-1}), moderate available

P_2O_5 (27.57 kg ha^{-1}) and adequate available K_2O (237.18 kg ha^{-1}) content. In case of sulphur content (15.25 ppm) it is marginal to deficient, while all available micronutrients (Zn, Fe, Mn, Cu) were in adequate quantity. There are six treatments where comprised with four replication as regarding to different proportion of urea and AS in the experiment. They are T_1 (U_{100}:AS_{00}), T_2 (U_{80}:AS_{20}), T_3 (U_{60}:AS_{40}), T_4 (U_{40}:AS_{60}), T_5 (U_{20}:AS_{80}) and T_6 (U_{00}:AS_{100}). Nitrogen was applied at the rate of 200 kg N ha^{-1} from different proportion of urea and ammonium sulphate as per the treatments. Experimental data generated during the Field experiment were analyzed statistically as per Randomized Block Design (Steel and Torrie, 1982). Nursery bed was prepared as per requirement of tobacco seed. When seedling was ready to transplant, were transplanted after the primary irrigation. The subsidiary irrigation was given as and when required. Topping was done at fifty percent flowering and desuckering was carried out as and when required. The physiological parameters like leaf length, width and thickness were also taken at fifty per cent flowering stage. When the tobacco was at maturity stage, the leaf of the crop was harvested in two rounds with about 15 day's interval between first and second harvest from the net plot. After sun drying leaves are weighed together to get the total cured leaf yield.

The leaf lamina samples were prepared for the chemical analysis by grinding in Wiley mill and screened through 60 mesh sieve. Wet digestion was followed for preparing acid extract to determine P by Vanado-molybdo phosphoric acid yellow colour method (Jackson, 1973), K by Flame photometric method (Jackson, 1973), S by Turbidimetric method (Choudhary and Cornfield, 1966) and micronutrients (Fe, Mn, Zn, Cu) by AAS method (Lindsay and Norvell, 1978). Soil samples were also collected from net plot area randomly selected four spots from 0-15 cm depth after the harvest of the crop. The samples were air-dried and passed through 2 mm plastic sieve and analyzed for EC (Jackson, 1973), pH (Jackson, 1973), organic matter (Walkley and Black method, 1934), Avail. N (Jackson, 1973), Avail. P_2O_5 (Olsen *et al.*, 1954), K_2O (Jackson, 1973), Avail. S (Chesnin and Yien, 1950) and micronutrients (Lindsay and Norvell, 1978).

RESULTS AND DISCUSSION

Effect of varying treatments on yield attributes of rustica tobacco

The data on physiological parameters are drawn in Table 1. The results revealed that all the parameters were significantly influenced by different treatments except plant height. The plant height was numerically higher (60.50 cm) due to nitrogen application in the proportion of 80:20 urea and ammonium sulphate. Ahmed *et al.* (1986) found that increased application of nitrogen increased the plant height and leaf area of Virginia tobacco in Bangladesh. In case of leaf length of the upper, middle and lower portions of the plant, it was significantly higher with T_2 treatment which was at par with T_1 treatment.

The upper portion of the leaf width was also significantly higher with T_2 and it was found at par with T_1 (U_{100}: AS_{00}) treatment. While in case of leaf width of middle and lower portions of the plant, it was significantly highest with T_2 treatment. Chang *et al.* (1984) noticed that leaf width and length were positively correlated with nitrogen application. Application of nitrogen up to 220 kg ha^{-1} significantly increased the leaf width of bidi tobacco noted by Patel *et al.* (2003).

Effect of varying treatments on leaf thickness and cured leaf yield of rustica tobacco.

The data showed that the leaf thickness was significantly higher with T_2 (U_{80}:AS_{20}) and it was found at par with T_1 treatment (Table 2). This finding collaborated with Patel (2013) for bidi tobacco. The cured leaf yield of rustica tobacco was significantly higher with N application through urea and AS in 80:20 proportion (T_2) and it was found at par with T_1 treatment which indicated that the beneficial effect of sulphur application on yield attributing characters and thereby it increased the yield of rustica tobacco. Djajadi *et al.* (1990) found increased

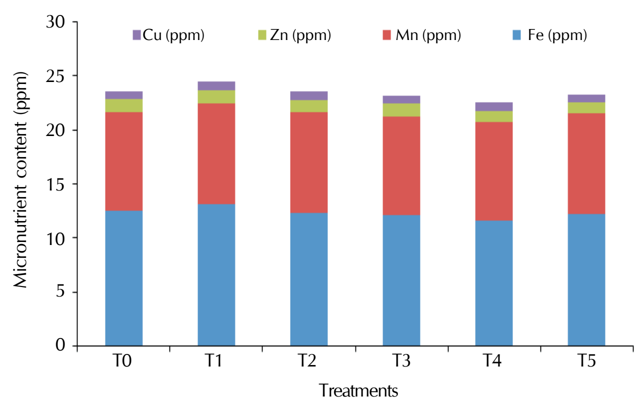

Figure 1: Effect of varying treatments on micronutrients availability after harvest of rustica tobacco

Table 1: Effect of varying treatments on yield attributes of rustica tobacco

Treatment	Plant Height (cm)	Leaf Length (cm) Upper	Middle	Lower	Width (cm) Upper	Middle	Lower
T_1	58.50	29.25	29.50	30.25	28.25	37.75	33.25
T_2	60.50	30.75	30.75	32.75	30.50	40.75	36.50
T_3	56.50	27.25	27.25	28.50	25.25	36.00	32.25
T_4	52.50	23.75	24.25	26.00	16.75	26.50	27.25
T_5	54.50	26.25	27.00	28.25	22.00	34.00	31.25
T_6	53.50	25.25	25.75	28.25	19.00	31.50	28.00
S.Em+	2.07	1.10	1.09	1.02	0.82	0.40	0.55
C.D. at 5%	NS	3.31	3.29	3.06	2.48	1.22	1.67
C.V. %	7.38	8.10	7.96	7.00	6.97	2.35	3.52

trend on yield due to increased application of nitrogen to rustica tobacco and bidi tobacco respectively.

Effect of varying treatment on quality parameters of rustica tobacco

Table 2: Effect of varying treatments on leaf thickness and cured leaf yield of rustica tobacco

Treatments	Leaf Thickness(mg/cm^2)	Cured Leaf Yield(kg ha^{-1})
T_1	29.25	3104
T_2	30.75	3203
T_3	27.25	2770
T_4	23.75	2149
T_5	26.25	2215
T_6	25.25	2203
S.Em+	1.10	133
C.D. at 5%	3.31	402
C.V. %	8.10	10.23

Table 3: Effect of varying treatments on quality parameters of rustica tobacco

Treatments	Nicotine (%)	Reducing sugar	Chloride
T_1	3.66	3.28	2.75
T_2	4.32	3.94	2.78
T_3	3.99	4.06	2.64
T_4	4.11	3.15	2.58
T_5	4.14	3.68	2.75
T_6	4.24	3.35	2.75
S.Em+	0.20	0.25	0.21
C.D. at 5%	NS	NS	NS
C.V. %	9.67	13.99	15.33

The results of different quality parameters like nicotine, reducing sugar and chloride contents of rustica tobacco presented in Table 3. The results revealed that none of the quality parameters significantly influenced due to different treatments. The nicotine and reducing sugar contents were numerically highest with T_2 and T_3 treatments respectively. However, the chloride content was not differing much due to different treatments and it was higher than 2 per cent which is beneficial for quality of rustica tobacco. Patel *et al.* (2013) observed increase in nicotine content and nicotine yield potential due to the sources and levels of sulphur in seed crop of bidi tobacco.

Effect of varying treatments on macronutrients content and uptake by rustica tobacco.

Table 4 showed results of major and secondary nutrients content and their uptake by rustica tobacco. The results indicated that the nitrogen content of the rustica leaf was increased with increasing level of sulphur through ammonium sulphate. It was significantly higher with T_6 treatment and found at par with T_5 and T_4 treatments. Similar increased in nitrogen content and uptake was reported by Klapheck *et al.* (1982). In case of phosphorus and potash contents of the leaf, they were found non-significant differences due to different treatments. The sulphur content of the leaf was significantly higher with T_6 and found at par with T_5 and T_4 levels. Tsai and Lin (1970) reported that there was no impact of sulphur addition on the P content while Nicholas *et al.* (1956) recorded increased K concentration in the leaf with the increased concentration of sulphur.

The uptake of N, P, K and S by plant was found significant variations due to different treatments. All these macronutrients uptakes were significantly higher with T_2 and found at par

Table 4: Effect of varying treatments on macronutrients contents and uptake by rustica tobacco

Treatments	Content (%)				Uptake (kg ha^{-1})			
	N	P	K	S	N	P	K	S
T_1	3.15	0.65	0.74	0.58	98.0	20.25	22.91	18.01
T_2	3.24	0.64	0.74	0.60	104.3	20.51	23.71	19.19
T_3	3.44	0.63	0.75	0.62	95.4	17.55	20.86	17.05
T_4	3.58	0.62	0.76	0.63	77.0	13.31	16.46	13.61
T_5	3.64	0.60	0.79	0.65	80.5	13.32	17.61	14.46
T_6	3.73	0.59	0.80	0.68	82.1	13.02	17.62	14.95
S.Em+	0.08	0.01	0.02	0.02	5.23	1.02	1.28	0.79
C.D. at 5%	0.25	NS	NS	0.05	15.78	3.06	3.88	2.40
C.V. %	4.74	11.69	4.79	12.46	5.12	12.98	5.41	9.84

Table 5: Effect of varying treatments on micronutrients content and uptake by rustica tobacco.

Treatments	Content (ppm)				Uptake (g ha^{-1})			
	Fe	Mn	Zn	Cu	Fe	Mn	Zn	Cu
T_1	1587	185	43	26.7	4934	574	135	83
T_2	1590	192	48	28.2	5104	618	154	91
T_3	1660	200	49	28.7	4597	554	134	79
T_4	1690	205	50	29.0	3616	443	108	62
T_5	1735	215	52	30.7	3841	476	115	68
T_6	1737	232	53	35.0	3833	512	117	77
S.Em+	43.5	5.8	1.32	0.72	243	31.5	6.24	3.99
C.D at 5%	NS	17.6	4.00	2.18	732	95.1	18.81	12.02
C.V. %	5.2	5.7	5.39	4.87	11.25	11.9	9.81	10.39

Table 6: Effect of varying treatments on soil properties and macronutrients after harvest of rustica tobacco

Treatment	EC	pH(1:2.5)	OC(%)	Available N kg ha^{-1}	P_2O_5	K_2O	S ppm
T_1	0.25	7.92	0.39	222	41.28	239.19	27.85
T_2	0.22	7.90	0.39	223	36.39	241.87	29.50
T_3	0.23	7.90	0.39	227	41.65	239.79	29.62
T_4	0.22	7.97	0.41	232	41.47	237.65	29.66
T_5	0.22	7.91	0.40	235	39.08	237.98	29.92
T_6	0.21	7.89	0.41	241	34.94	229.81	30.92
S.Em+	0.01	0.506	0.02	8.91	1.38	6.49	0.52
C.D at 5 %	0.02	NS	NS	NS	4.17	NS	1.55
C.V. %	6.60	12.78	8.98	7.74	7.06	5.46	3.49

with T_1 and T_3 treatments. In bidi tobacco leaf, sulphur content was 0.47 and 0.53 per cent in case of urea and ammonium sulphate respectively (Anon., 1980). Such increases in N, P, K and S contents of leaf by sulphur addition are reported by Gowaikar and Shah, 1961.

Effect of varying treatments on micronutrients content and uptake by rustica tobacco.

The data of micronutrients content and uptake by rustica tobacco are given in **Table 5**. The results indicated that the beneficial effect was observed with increasing proportion AS on all micronutrients content and uptake of rustica tobacco. The micronutrients content and uptake were found significant variations due to different treatments except the Fe content of the leaf. The Fe content was numerically highest with T_6 treatment. The Mn content of the leaf was significantly higher with T_6 treatment and found at par with T_5 treatment. In case of Zn content of the leaf, it was also significantly higher with T_6 and found at par with T_5 and T_4 treatments. The Cu content was significantly highest with T_6 treatment.

The uptake of Fe, Mn, and Cu were significantly higher with T_2 treatment and found at par with T_1 and T_3 treatments. While Zn uptake was significantly higher with T_3 and found at par with T_1 treatment only. Pundrikakshudu (1974) reported the Fe and Cu concentrations in bidi tobacco lamina were 1060 ppm and 16.8 ppm respectively for A-2 variety. Tsai and Lin (1970) also reported that the Mn content was not significantly altered by increased in sulphur concentration. Manganese content of leaf was within the range reported by Pundrikakshudu (1974). The values of zinc were higher than the prescribed general deficiency level of 20 ppm in the leaf (Singh, 1984). The values of copper content was also higher than reported in bidi tobacco leaves as reported by different workers ranged from 10.0-26.2 ppm (Ghelani, 1985).

Effect of varying treatments on soil properties, macronutrients and micronutrient content after harvest of rustica tobacco.

The results indicated that none of the parameters found significant differences due to different treatments except the phosphorus and sulphur contents of soil (Table 6). The EC and pH of the soil after the harvest of rustica tobacco were numerically lowest with treatment T_6 (U_{00}:AS_{100}). The N and S contents were increased with increasing proportion of AS for N application. The N content of the soil was numerically highest while K_2O content was numerically lowest with T_6 treatment. The significantly lowest value of S content was recorded with T_1 treatment. The P_2O_5 content of soil was significantly lower with T_6 and found at par with T_5 treatments. Cooke (1967) reported that the fertilizer use efficiency of AS was 85 per cent as against 70 per cent of urea. Higher total N present in the soil due to increased sulphur addition through AS might be due to higher rate of fixation of applied N from ammonium sulphate compared to urea. Vakharia (1979) reported that sulphur application increased water soluble S content of soil by 34 per cent after the harvest of crop. Reddy and Mehta (1970) stated that total-S content in the soils of Kaira and Baroda districts of Gujarat ranged from 42 to 113 ppm with an average of 74 ppm.

All the micronutrients were found non-significant variation due to different treatments (Fig. 1). All the micronutrients were numerically highest with nitrogen application through urea and ammonium sulphate in the proportion of 80:20 (T_2). Darusman *et al.* (1991) observed that nitrogen fertilization caused an increase in micronutrients like Fe, Mn, Zn and Cu. Kumar *et al.* (1993) also indicated that chemical fertilizer application decreased soil pH and increased the availability of micronutrients in soil. Hemlatha *et al.* (2013) recorded the lowest values of available Zn content of the soil due to the application of higher levels of N and P at Coimbatore.

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