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Effect of Different Organic Manures in Conjunction with Inorganic Fertilizers on Physiological Parameters and Nutrient Uptake of FCV Tobacco Grown in Irrigated Alfisols of Andhra Pradesh

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Abstract: *A field experiment was conducted to study the effect of different organic manures along with chemical fertilizers on net photosynthetic rate, leaf area index, chlorophyll pigments and also nutrient uptake of FCV tobacco in irrigated Alfisols (Typic Ustochrept). The experiment was conducted during 2013-14, in split plot design with five main treatments, (no farm yard manure, FYM 5 t/ha, FYM 10 t/ha, Tata geo green(TGG) a sugarcane based organic manure, 1t/ha, TGG 2 t/ha) and four sub-plots (No RDF, 50% RDF, 75% RDF and 100% RDF) replicated four times. Results revealed that application of 100% and 75% RDF showed significantly higher net photosynthetic rate and chlorophyll pigments (a&b) over 50% RDF and control. Application of 10 t/ha FYM showed highest LAI compared to other organic manures at 60 and 95 days. Organic manures and their doses showed significant increase in nutrient uptake over control. Application of 100% RDF has recorded significantly higher N, P and K uptake at 60 and 95 DAP. Organic manures showed significantly higher total nitrogen and phosphorus and potassium uptake over control. FYM 10 t/ha showed higher nitrogen and phosphorus uptake over TGG. Application of fertilizers @ 100% RDF showed significantly higher total N,P and K uptake compared to other treatments. Based on the physiological parameters and nutrient uptake it can be concluded that among the sources, FYM 10 t/ha was superior to TGG. In the event of non-availability of FYM, TGG (1 t/ha) can be used as a source of organic manure.*

Keywords: *FCV tobacco, FYM, LAI, NPR, Nutrient uptake, and Tata Geo Green.*

INTRODUCTION

Tobacco is one of the important commercial cash crops grown in India and plays vital role in the Indian economy. It is cultivated in an area of four lakh ha producing 830 M kg annually. Among the different tobacco types, FCV tobacco occupies 38% of total tobacco production. FCV tobacco is mainly cultivated in Andhra Pradesh and Karnataka. In Andhra Pradesh it is cultivated in four different zones. In Northern Light Soils of Andhra Pradesh, FCV tobacco is cultivated in 28,850 ha producing 64 million kg. FCV tobacco grown in this zone is semi flavourful and is being exported to other countries. Northern Light soils are sandy loam, slightly acidic, low in organic carbon, nitrogen, medium available K, high in available P with low water holding capacity. Application of organic manure is essential for managing soil health, increasing yields (10-15%), and also imparts required flavour and taste to tobacco as per the consumer's preference [8]. Farm yard manure/ green manures are the recommended organic sources for FCV tobacco before tobacco planting. In view of scarcity for FYM, there is a need to find out an alternative source to FYM for FCV tobacco. Tata Geo Green is a pressmud along with sugarcane bagasse and broiler ash treated with microbial cultured spent was which is dried. Use of organic

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manures alone might not meet the plant requirement due to limited availability and presence of relatively low levels of nutrients. Perverse to detrimental effects of inorganic fertilizers, organic manures along with chemical fertilisers improve soil health resulting in enhanced crop yield [9]. Field experiment was conducted to assess the effects of organic manures (TGG and FYM) applied with and without chemical fertilizers on physiological, nutrient uptake and nutrient use efficiency of FCV tobacco.

MATERIALS AND METHODS

Field experiment was conducted during *rabi* 2013-14 at ICAR-CTRI, RS, Jeelugumilli, West Godavari district, Andhra Pradesh. Experimental soil are sandy loam (*Typic Ustochrept*), slightly acidic (pH 5.90), low in soluble salts (0.12 dSm^{-1}), organic carbon (0.18 %), high in available phosphorus (38.4 kg ha^{-1}), and medium in available potassium (146.2 kg ha^{-1}). The experiment was conducted with test variety Kanchan in a split plot design with five main treatments (No farm yard manure (FYM), FYM 5*t*/ha, FYM 10 t/ha, Tata Geo Green (TGG) 1 t/ha and TGG 2 t/ha), four sub-plot treatments (No fertilizers, 50% RDF, 75% RDF and 100% RDF) with 4 replications. Tobacco seedlings (60 days old) were transplanted at 100 X 60 cm spacing. FYM and TGG were applied before planting.

Recommended fertiliser dose for FCV tobacco in this zone was 115-60-120 kg/ha. Fertilizer sources for N,P and K were CAN, DAP, and SOP respectively and were applied in three splits at 10, 25-30 and 45 days after transplanting as per the schedule. All the recommended practices were followed in raising the crop. Physiological parameters like, net photosynthetic rate, chlorophyll pigments [16] and leaf area index (LICOR-3100C) were recorded at 60 and 95 DAP. The plant samples (leaf, stem and root) were collected at 60 and 95 DAP. Cured leaf, stem and root samples were collected after harvest. These samples were dried powdered and analysed for nutrient composition using standard operating procedures [7] and nutrient uptake was computed.

RESULTS AND DISCUSSION

Physiological Parameters

Results revealed that among the organic manures much variation was not observed in chlophyll a,b and total pigments. Increase in dose of the manure also not shown any significant variation. Application of fertilizer doses showed improvement in pigments. Application of 50% RDF recorded significantly higher pigments (2.28 μ g/g) over the control (1.022 μ g/g). Fertilizer doses 75% RDF and 100% RDF showed no variation among themselves in different pigments but significantly higher than 50% RDF and control (Figure 1). Leaf area is an important parameter among plant growth characters particularly for interception and conversion of solar energy for effective synthesis of substances. Application of organic manures showed higher LAI at 60 and 95 days after transplanting (Figure 2 and 3).

Organic manure application benefits could be due to the fact that after proper decomposition and mineralization, manures supplied available nutrients directly to the crop which resulted in increase in LAI, and also helped better nutrient utilisation through better moisture holding capacity. Similar results were observed by Nehra [11]. Net Photosynthetic rate (NPR) is a measure of photosynthesis in excess of respiration demand. NPR increased with increase in fertilizer dose. Each successive increase in fertilizer dose increased the NPR significantly. Highest NPR was observed in 100% RDF.

The application of higher fertiliser fertilizers doses helped to increase the LAI, which made possible to increase photosynthetic area and thereby NPR. (Figure 4). Increase in level of nutrients increased the chlorophyll pigments, leaf area index and there by net photosynthetic rate. Datta [4], reported that application of organic manures along with fertilizers has improved the leaf area index, chlorophyll pigments, crop growth rate and net assimilation rate of *Brassica capestries.* Application of different organic manures has not shown any significant variation among themselves and even with control in net photosynthetic rate.

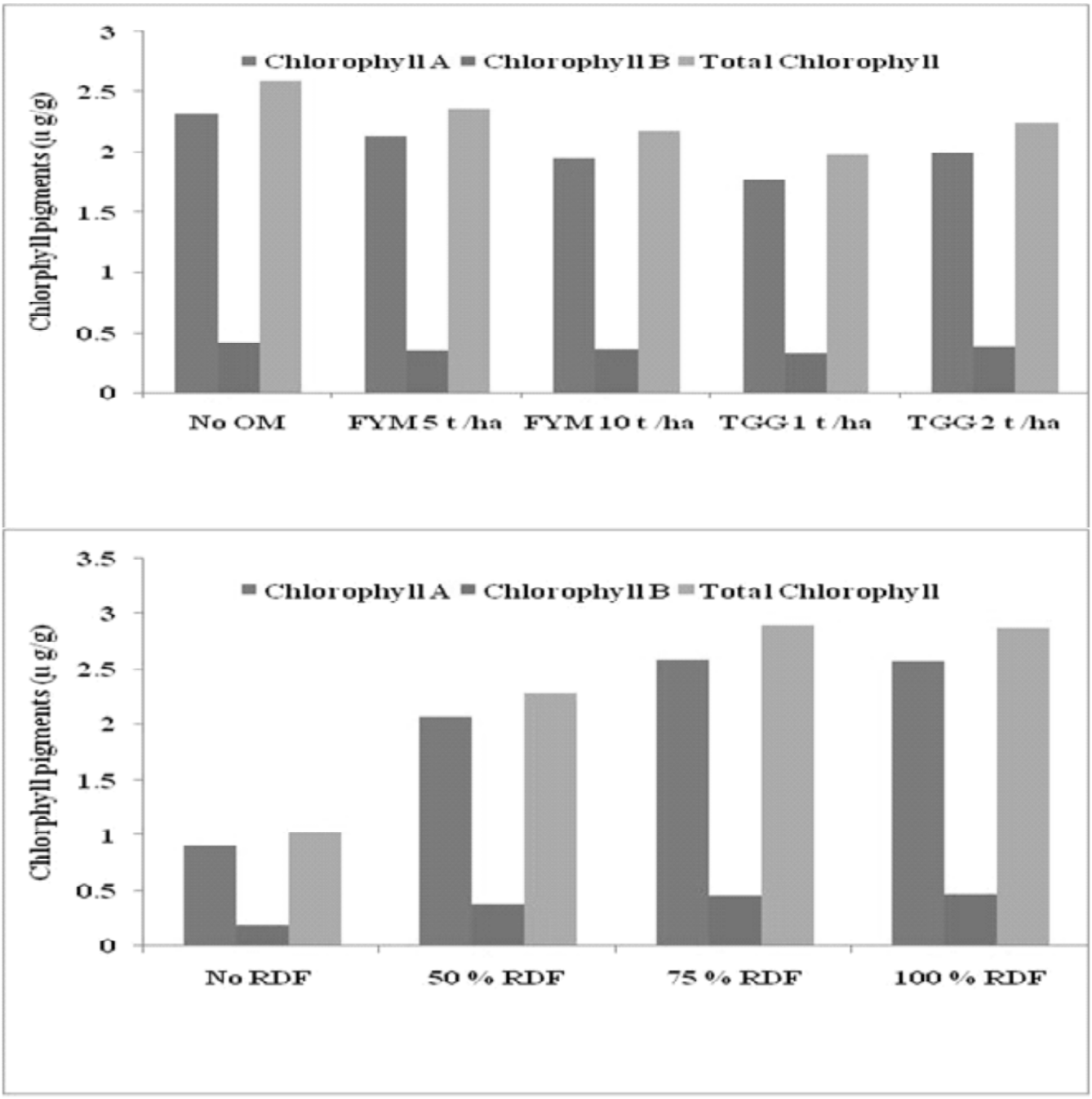

Figure. 1 Effect of different organic manures and fertiliser doses on chlorophyll pigments of FCV tobacco (Var. Kanchan) in irrigated Alfisols

Nutrient Uptake FCV Tobacco

Results indicated that uptake of major nutrients (NPK) increased with the age of the plant. Among the three nutrients, uptake of nitrogen is more than other two nutrients at each stage. Increase in fertilizer dose over organic manure increased the nutrient uptake. An increase in level of nutrients increased the leaf-area index and the photosynthetic pigments, resulting in more photosynthesis and there by increased the nutrient uptake. Application of organic manures *viz*., FYM and TGG showed significantly higher uptake over the control.

In general highest uptake was observed in FYM at 10*t*//ha. At 60 DAP 10*t*/ha FYM showed significantly higher N uptake over the TGG. At 95 days organic manures were not significantly differed in N uptake. Farm yard manure also showed its significant superiority in P uptake over

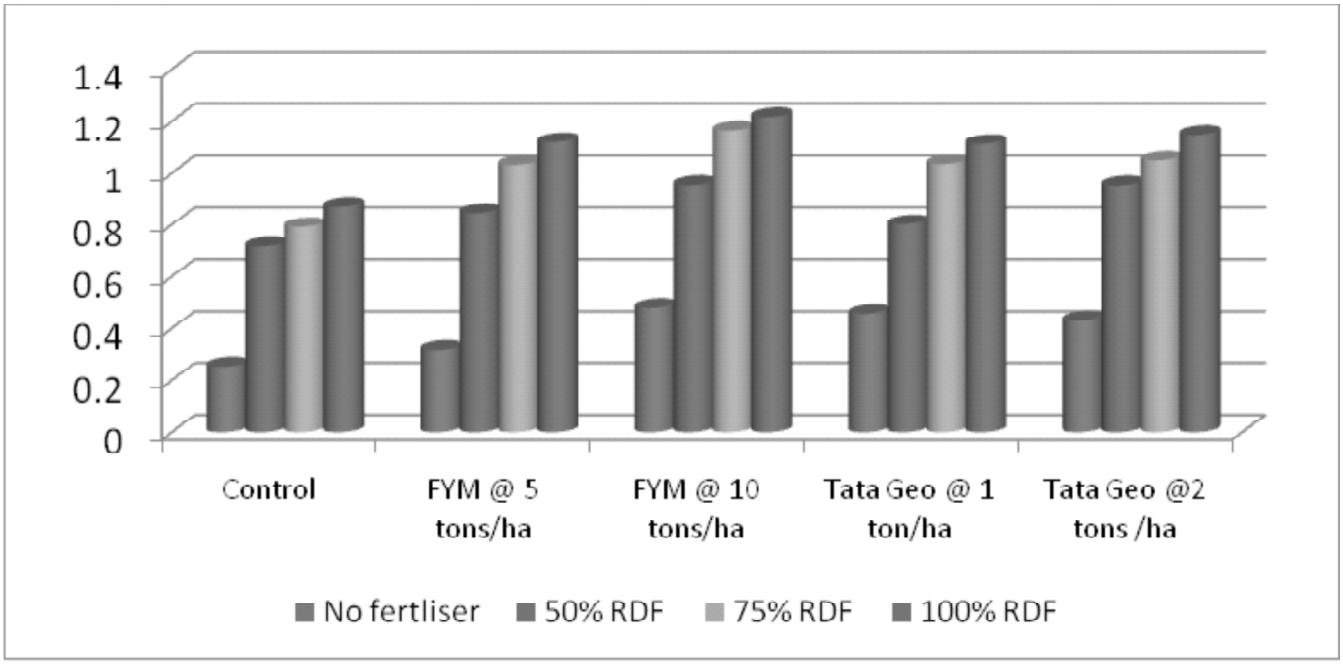

Figure 2: Effect of organic manures and fertiliser doses on Leaf Area Index (LAI) of FCV tobacco grown in irrigated alfisols at 60 Days after planting

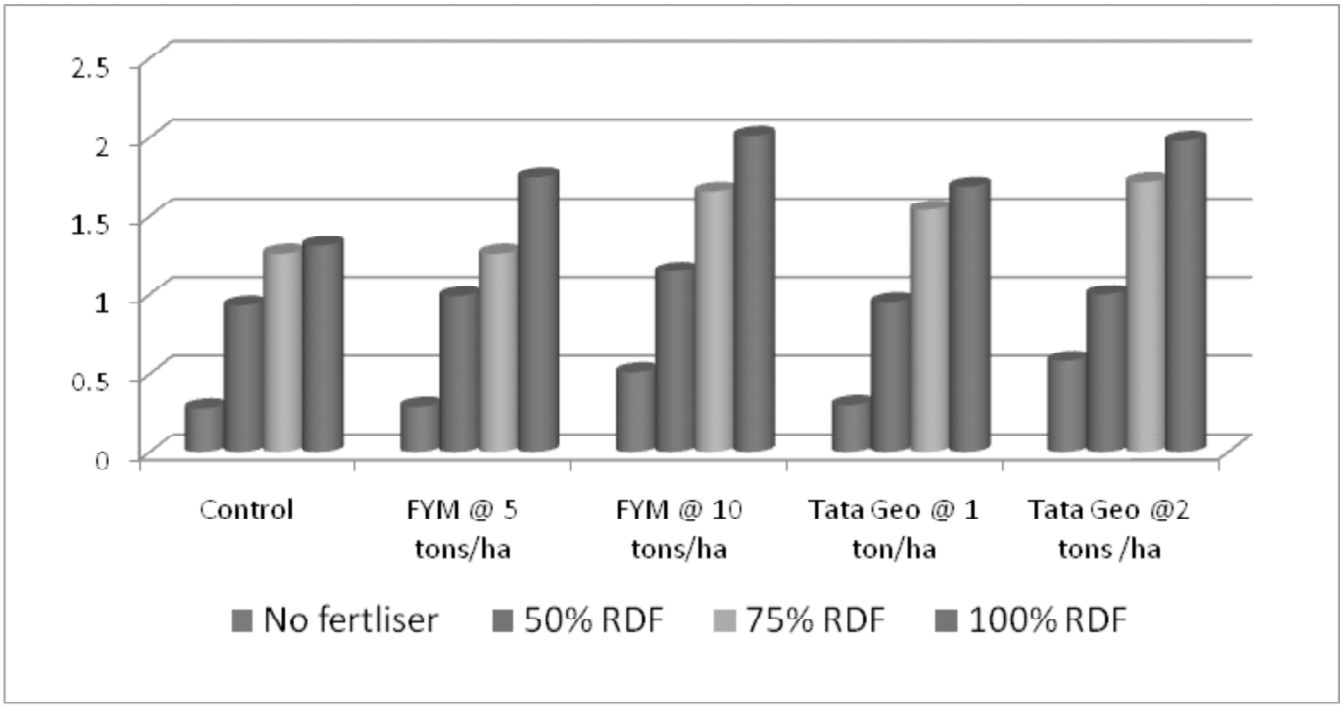

Figure 3: Effect of organic manures and fertiliser doses on Leaf Area Index (LAI) of FCV tobacco grown in irrigated alfisols at 95 Days after planting

TGG at 60 DAP and 95 days. At 60 DAP increase in dose of organic manures increased the K uptake and FYM 10 t/ha, TGG 1&2 t/ha showed significantly higher K uptake over FYM 5t/ha. At 95 days TGG 2 t/ha showed significantly higher K uptake over other organic manure treatments. Increase in fertilizer doses increased the N, P and K uptake at both 60 and 95 DAP (Table 1). Gopalachari [6] reported that maximum percentage of dry matter and nutrient uptake occurred during reproductive stage (60-90) followed by active vegetative stage (30-60 days) in FCV tobacco. Total nutrient (N, P and

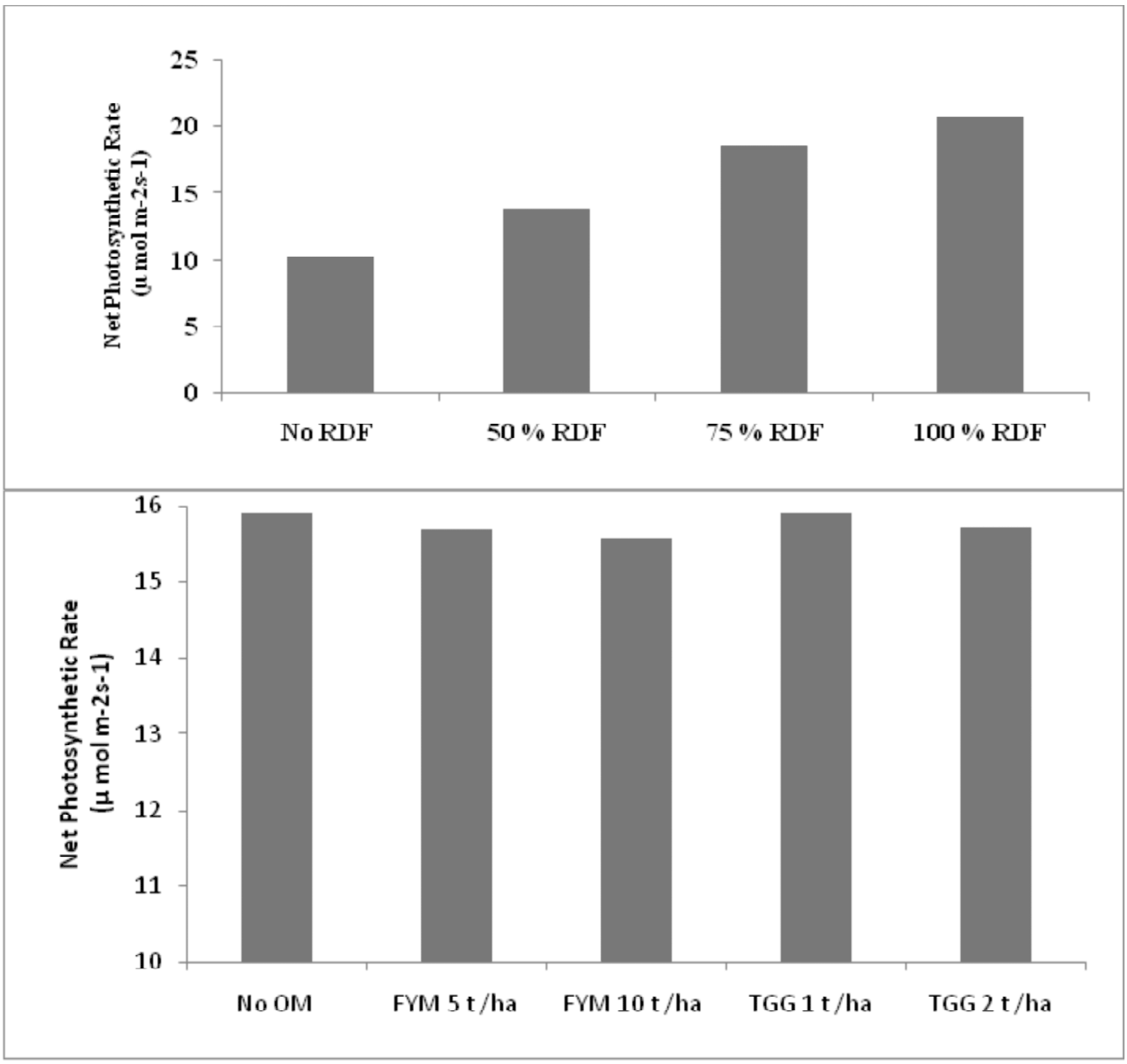

Figure 4: Effect of different organic manures and fertilisers on Net photosynthetic rate of FCV tobacco (Var. Kanchan) in irrigated Alfisols

K) was computed by the sum of the uptake in individual plant parts (Lamina, mid rib, stem and root). In case of lamina, the uptake in different plant positions was determined separately and total lamina uptake was computed and the results were presented in Table 1. Organic manures (FYM and TGG) showed significantly higher nitrogen uptake over control. FYM 10 t/ha showed higher nitrogen uptake compared to its lower dose (5 t/ha) and also TGG (1&2 t/ha). Increase in fertilizer doses increased the nitrogen uptake significantly. Application of fertilizers @ 100% RDF showed significantly higher uptake compared to other treatments, higher proliferation of roots in N-applied treatment, which could have resulted in higher uptake of nutrients [3] Phosphorus uptake in organic manure treatments was significantly higher compared to control where no organic manure is applied. FYM @ 10 t/ha showed significantly higher 'P' uptake over TGG (1&2 t/ha). Increase in fertilizer doses over organic manures showed progressive and significant improvement

Table 1
Effect of different organic manures on nutrient uptake (kg/ha) and fertiliser use efficiency (%) of FCV tobacco (Var. Kanchan) grown in irrigated alfisols

	60 DAP			*95 DAP*			*Total plant uptake*			*Fertiliser use efficiency*
Treatments	*N*	*P*	*K*	*N*	*P*	*K*	*N*	*P*	*K*	*NPK*
Main plots										
No OM	12.0	1.6	7.0	19.4	2.6	12.9	40.0	8.2	39.5	
FYM 5 t /ha	16.6	2.4	10.4	22.0	3.6	16.2	47.5	10.2	53.3	7.91
FYM 10 t /ha	17.5	2.6	14.6	23.2	4.7	19.1	50.1	12.8	57.5	11.07
TGG 1 t /ha	14.8	1.8	12.6	18.7	3.0	17.6	45.2	9.6	56.3	7.93
TGG 2 t /ha	14.6	1.6	14.8	22.4	3.5	23.2	45.5	10.3	58.1	8.88
SEm±	0.6	0.1	0.4	1.4	0.2	1.0	1.5	0.4	1.5	
CD at 5%	1.9	0.2	1.4	4.6	0.7	3.2	4.8	1.3	4.8	
CV%	13.4	10.6	12.8	23.3	20.9	19.6	11.5	13.7	9.9	
Sub Plots										
No RDF	4.4	0.7	4.6	5.7	1.1	5.1	16.6	5.1	26.7	
50 % RDF	12.9	1.9	12.3	17.4	3.3	14.9	43.1	10.5	52.8	19.66
75 % RDF	20.0	2.5	14.9	25.7	4.1	22.5	54.2	11.6	63.2	27.30
100 % RDF	23.0	2.9	15.7	35.7	5.4	28.6	68.6	13.7	69.0	34.87
SEm±	0.7	0.1	0.5	1.0	0.2	1.0	1.3	0.2	1.2	
CD at 5%	2.0	0.2	1.3	2.9	0.5	2.7	3.5	0.7	3.3	
CV%	18.6	16.5	14.9	18.8	18.7	21.2	10.8	9.2	8.8	

in P uptake. Potassium uptake in no manure treatment was significantly low compared to other organic manure treatments.

Organic manures and their doses did not show any significant differences among themselves in K uptake. Application of N P K fertilizers over and above the organic manures showed significant increase in potassium uptake. The interaction between main plots and sub plots was not significant (Table 1). The higher NPK uptake may be due to higher yield received in these treatments. Similar findings were also reported by Sathish [14]; Ramalakshmi [12] Satheesh and Balasubramanian [13], reported that total nutrient uptake by rice crop differed significantly due to organic-manures and application of farmyard manure + neemcake resulted in higher uptake (102.1 kg ha^{-1}), which was 20.7% more compared to chemical N fertilizers alone. Thirunavukkarasu [15] reported, the percent increase of N, P and K uptake at harvest stage with the application of pressmud @ 5 t ha^{-1} along with 50 per cent RDF over control was 58%, 156% and 51% respectively. Agbede and Adekiya [1] who had reported that increased nitrogen uptake might be due to the greater availability of nitrogen in soil which enhanced the plant growth and ultimately lead to higher accumulation of nutrients in their parts along with highest total uptake. Attarde [2] and Mathew and Kuruvilla [10] reported that the microbial decomposition of added organic sources release several organic acids, which results in reduction in soil pH and solubilize the native soil nutrient which ultimately enhanced the uptake of plant.

Fertilizer Use Efficiency

Application of organic manures increased the fertilisert use efficiency of FCV tobacco with maximum FUE recorded with FYM 10 t ha^{-1} (11.01%). Increase in fertiliser doses over the organic manures increased the fertiliser use efficiency, highest being observed with 100% RDF (34.87%).

similar results of improved the nutrient use efficiency were observed in urdbean-wheat system with the application organic manures (Ganjax Math [5]; Satheesh and Balasubramanium, [13]; and this could be ascribed to the increased uptake of nutrients in plant in the above treatments. From the present study it can be concluded that for FCV tobacco grown in light textured soils, application of organic manures is very much essential as they have pronounced effect on physiological parameters, nutrient uptake, and Fertiliser use efficiency of NPK. In the event of non- availability of FYM, TGG can be applied as a source of organic manure.

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