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Effect of graded levels of potassium on productivity, quality and Root Knot nematode incidence in FCV tobacco in KLS.

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ABSTRACT

Field experiments were conducted with graded levels of Potassium application (0,60,120,180 and 240 Kg/ha) in both root knot sick and root knot free soils separately in farmer's field conditions of FCV tobacco growing area of Periyapatna of Mysore district in Karnataka Light Soils (KLS) during *kharif* seasons of 2009-10 and 2010-11. The experimental soils were red sandy loam in texture with slightly acidic to neutral in soil reaction (PH 6.1-6.5), poor in soil organic carbon (0.35%), medium to high in available phosphorus (25-55 kg/ha) and potassium (280-400kg/ha). The cured leaf productivity was lower in root knot sick site compared to the root knot free site in both the years of the study. The productivity of cured leaf was significantly increased by 21.9% by application of higher levels of K_2O (180 and 240 kg/ha) compared to control (no K application) in the root knot sick soils while the same was increased by only 10 % in the root knot free soils. The K_2O application beyond 120 kg/ha did not show significant improvement in the productivity in the root knot free soils, while the response to the same was seen up to 180 kg K/ha in the root knot sick soils indicating need for higher level of potassium application for maximizing the productivity levels in the root knot infested soils in KLS. The RKI was significantly higher at 3.68 in the control (without Potash application) compared to RKI value of 2.65 at 180 kg K_2O /in RK Sick soils. But in the Root Knot free soils, the reduction in RKI due to increased levels of K_2O was not significant among different levels of K_2O. The cured leaf quality parameters were not largely influenced by the levels of K in both the soils and were in the normal acceptable range for KLS soils. The leaf K_2O content increased by 48% in the root knot sick soils by application of higher K_2O levels. The study has revealed that there is likely need for higher application of potash than the recommended dose of 120 kg/ha for optimizing the productivity and quality in highly root knot infected areas for sustaining FCV tobacco cultivation in KLS.

Flue Cured Virginia (FCV) tobacco (*Nicotiana tabacum*) is an important commercial crop grown under rainfed situation in the Southern Transitional Zone of Karnataka. As more than 80% of the produce is exported, sustaining its productivity and quality over the years is very important. FCV tobacco growing soils of the region are sandy to sandy loam in texture with poor moisture retention and Cation Exchange Capacity greatly affecting the nutrient uptake, productivity and quality of the crop considerably. The soils have become prone to nematode infestation due to continuous monocropping of FCV tobacco without proper crop rotation practices and organic application. Among major nutrients, potassium plays a major role in FCV tobacco and the proper uptake of potassium is very important for sustaining the quality and productivity of KLS tobacco in the international market. Nutrient uptake studies on FCV tobacco under KLS conditions revealed that the crop removes as high as 96 kg K_2O per hectare (*Krishnamurthy, et al.,* 2003). The uptake of K by FCV tobacco is hindered largely due to the abiotic factors like sandy nature and poor moisture availability during the crop growth under red sandy loam soils of KLS. Apart from this, the potassium uptake by the plant is also known to be severely hampered due to biotic stresses like root knot infestation under field conditions. Incidentally the soils are also prone to biotic stresses like nematode infection and wilt disease

(*Ramakrishnan et. al.* 2004). The degree to which K uptake is hindered depends on the root knot infection levels and the K supplying capacity of the soils. Of all the nematode species surveyed, *Meloidogyne incognita* was found to be the most dominating type severely affecting the FCV tobacco production in Mysore district (*Ramakrishnan et .al .2001)*. In the absence of nematode resistant varieties, following suitable crop rotation practices with non host crops, early stalk and root destruction, deep summer ploughing and adequate Potassium nutrition play an important role in overall management of root knot nematode in red sandy loam soils of KLS. The present experiment aims at studying the effect of increased levels of K on cured leaf productivity levels, K uptake pattern, leaf quality parameters and root knot infection in the FCV tobacco grown under both root knot sick soils and root knot free healthy soils under KLS conditions.

MATERIALS AND METHODS

Field experiments were conducted with graded levels of K_2O application in root knot sick (R.Thunga) and rot knot free (H M Patna) locations separately in FCV tobacco growing areas of Periyapatna region in Mysore District in Karnataka Light Soils (KLS) . The experiment was conducted during 2009-10 to *2010-11 kharif* seasons in Randomized Block Design with four replications. The experimental soils were red sandy loam in texture with slightly acidic to neutral in soil reaction (PH 6.1-6.5), poor in soil organic carbon (0.35%) status, medium to high in available phosphorus (25-55kg/ha) and potassium (280-400 kg/ha). The graded levels of Potassium (0,60,120,180 and 240 Kg K_2O / ha) were imposed in two splits (10 and 30 DAT) in both the root knot sick and root knot free soils as per the treatments. The recommended dose of N and P_2O_5 @ 60:40 kg/ha in the form of CAN, DAP were applied common to all the treatments while the different doses K was applied in the form of SOP. Early planting (in the fourth week of May) with popular variety Kanchan was done with recommended spacing of 100 x 55 cm adopting plot size of 10.0 m x 3.3 m. The productivity of Cured leaf was recorded for each treatment in both the locations. Chemical parameters like nicotine, reducing sugars and chlorides and the leaf K content were analyzed using standard procedures. The stalks were uprooted at the time of final harvest and root-knot index (RKI) for nematode infection was also recorded. The data were statistically analyzed and interpreted based on the mean value of two years.

RESULTS AND DISCUSSION

The cured leaf productivity in general was lower in Root knot sick location of R. Thunga village compared to Root Knot free soils of HM Patna (1485 kg v/s 1666 kg /ha). The average root knot infection was at RKI 2.86 in Root Knot sick soils compared to 0.98 in Root Knot free location (Table 1).

The productivity of cured leaf was significantly increased by 21.9% by application of K_2O @180 kg/ha as compared to no potassium treatment in the root knot affected soils while the same was increased by 10.9% in root knot free soils (Table 1). Application of K_2O beyond 120 kg/ha did not show any significant improvement in the productivity levels of cured leaf in the root knot free soils while the yield response was observed up to 180 kg/ha in Root knot sick soils. Application of 120 kg/ha was found to be optimum Potassium dose for normal soils (*M.Mahadevaswamy and Krishnamurthy, 2006*) in KLS for maximizing both cured leaf productivity and top grade equivalent.

The root knot Index was significantly higher at 3.68 in control (without K application) compared to 2.65 at 180 kg K_2O level/ha in sick soils. But in the root knot free soils, the reduction in RKI due to increased levels of K was not significant (RKI 1.29 in control i.e., no potash application as compared to RKI of 0.81 to 0.86 at higher Levels of K). This indicates that in soils with high population of root knot nematodes, application of relatively higher dose of K would possibly reduce the RKI and thus encourages more K uptake resulting in better yields compared to lower or no K application levels. This may be due to better resistance offered by root system by way of thickening of the fibrous root system and production of antibodies against root knot nematodes. Studies on the mechanism by which the fertilizer affects the nematode population have revealed that the fertilizer components may be directly lethal to nematodes or they may alter both pH and salinity of the soil harboring nematodes. The application of phosphonate fertilizers induced a systemic acquired resistance against root knot nematodes in tomato seedlings (*Sameer Habah and Luma Al Banna*, *2011*). Application of double the dose of potash than recommended dose along with bio-agents improved the growth as well as biochemical parameters and reduced the number of galls caused by *Meloidogyne incognita* per root system in *Phaseolus vulgaris* (*Sherif et.al, 2014*). A decrease in the incidence of root knot nematodes on flue cured tobacco as a result of lime application has also been observed. The reduction was apparently related to increase in the soil PH rather than the additional calcium and Magnesium.

. The effect of K levels on the cured leaf quality indicated that various parameters like nicotine, reducing sugars and chlorides did not vary much due to the levels /graded application of K_2O in both root knot sick and root knot free soils (Tables 2 (a) and (b).) In general the nicotine content tend to be higher at higher K levels in Root Knot sick soils compared to Root Knot free soils possibly due to relatively lesser K uptake, however the values were in the normal acceptable range as observed for KLS conditions. The leaf chlorides content were well below the threshold limits in both the soils.

The effect of graded levels of K on cured leaf N, P, and K content are given in Table 3 (a) and 3(b). Relatively higher leaf N and K content were observed in Root knot free location as compared to RK sick soil location. However Leaf P content remained more or less same at both the locations. The leaf K content tend to increase with increased levels of K_2O application up to 180 kg/ha in X position and up to 240 kg/ha in L position in Rot knot sick soils, while the increased leaf K response was seen up to 120 kg/ha only in root knot free conditions. The study has clearly indicated the need for application of higher doses of Potassium nutrient to overcome the adverse effects of Root knot nematode infestation in KLS soils along with other agronomic practices like crop rotations and summer ploughings for optimizing the productivity and quality of FCV tobacco in Karnataka Light soils.

Table 1 .Effect of K levels on cured leaf yield Productivity in root knot sick and root knot free soils

Treatments	Cured leaf productivity (kg/ha)		Root Knot Index (RKI)	
	Root knot sick Location	Root knot free Location	Root knot sick Location	Root knot free Location
Control (No K_2O)	1313	1550	3.68	1.29
60 Kg K_2O/ha	1409	1654	2.91	1.06
120Kg K_2O/ha	1507	1704	2.65	0.90
180Kg K_2O/ha	1601	1720	2.55	0.86
240Kg K_2O/ha	1595	1702	2.51	0.81
S.Em±	116.8	59.0	0.17	0.15
C.D. at 5%	254.5	121.8	0.36	0.31

Table 2 (a).. Effect of K levels on cured leaf quality characteristics in Root Knot sick soils

Treatments	X Position (%)			L Position (%)		
	Nicotine	R.S.	Chlorides	Nicotine	R.S.	Chlorides
control (No K_2O)	1.66	14.81	0.21	2.78	20.15	0.20
60 Kg K_2O/ha	1.41	15.21	0.17	2.61	19.50	0.19
120Kg K_2O/ha	1.24	16.54	0.26	2.51	19.49	0.19
180Kg K_2O/ha	1.56	15.02	0.19	2.48	22.00	0.17
240Kg K_2O/ha	1.24	17.25	0.21	2.54	21.58	0.16

Table 2 (b). Effect of K levels on cured leaf quality characteristics in RK free soils

Treatments	X Position (%)			L Position (%)		
	Nicotine	R.S.	Chlorides	Nicotine	R.S.	Chlorides
control (No K_2O)	1.09	22.64	0.33	2.15	21.05	0.29
60 Kg K_2O/ha	1.11	21.06	0.49	2.32	18.38	0.33
120Kg K_2O/ha	1.12	21.15	0.41	1.68	20.48	0.29
180Kg K_2O/ha	0.86	25.25	0.32	1.96	19.58	0.32
240Kg K_2O/ha	0.88	22.67	0.40	2.23	20.35	0.28

Table 3 (a). Effect of K levels on cured leaf NPK content in RK sick soils

Treatments	X Position (%)			L Position (%)		
	N	P	K	N	P	K
Control (No K_2O)	2.30	0.25	2.92	2.65	0.25	2.40
60 Kg K_2O/ha	2.41	0.24	3.00	2.77	0.28	2.55
120Kg K_2O/ha	2.40	0.21	3.22	2.99	0.26	2.97
180Kg K_2O/ha	2.36	024	3.40	2.95	0.26	3.35
240Kg K_2O/ha	2.24	0.22	3.29	2.66	0.27	3.57

Table. 3(b). Effect of K levels on cured leaf NPK content in RK free soils

Treatments	X Position (%)			L Position (%)		
	N	P	K	N	P	K
Control (No K_2O)	2.85	0.19	3.35	3.05	0.27	3.15
60 Kg K_2O/ha	3.09	0.18	3.35	3.50	0.34	3.15
120Kg K_2O/ha	2.63	0.18	3.55	3.41	0.26	3.50
180Kg K_2O/ha	2.64	0.26	3.52	3.50	0.29	3.51
240Kg K_2O/ha	2.74	0.23	3.50	3.75	0.27	3.49

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