Tobacco Research 42(2) : 59-63, 2016

ASSESSMENT OF POTASSIUM USE EFFICIENCY IN FCV TOBACCO GENOTYPES UNDER NLS CONDITIONS

D. DAMODAR REDDY, M. ANURADHA, V. KRISHNAMURTHY AND T.G.K. MURTHY

ICAR - Central Tobacco Research Institute, Rajahmundry – 533 105

(Received on 2nd August, 2016 and accepted on 11th November, 2016)

Potassium (K) is the key nutrient required in large quantity for optimum yield and quality of tobacco (*Nicotiana tobacum* L.) grown on K deficient Alfisols under NLS conditions. Identification and use of genotypes efficient in K uptake and utilization may be a promising strategy to improve yield and reduce costly input of K fertilizers (SOP) in FCV tobacco production. A field experiment on K deficient Alfisols at CTRI Regional station, Jeelugumilli was conducted to evaluate FCV tobacco genotypes for their potassium use efficiency. Treatments for the field experiment included eighteen FCV tobacco genotypes (16/103, Mc Nair-12, CM-12, Kanchan, NLSH-1, NLST-2, NLST-3, NLST-4, TOBIOS-2, RT-30-1, RT-36-1, RT-42-1, RT-47-1, RT-51-2, RT-57-1, RT-67-3, RT-90-1, RT-102-1) grown with and without 120 kg K_2O/ha. Plants were harvested treatment wise at the age of 65 DAT. Data on dry matter yield, K concentration and uptake in different plant parts were recorded. K use efficiency was computed in terms of agronomic efficiency (AE), physiological efficiency (PE), recovery efficiency (RE) and internal use efficiency (IUE). Results revealed that in absence of K addition, all the genotypes showed a significant reduction in biomass production. Among the genotypes highest shoot biomass was recorded for RT-51-2 highest biomass. Genotypes showed differential yield response to applied potassium. Among the genotypes RT-51-2, RT-57-1and TOBIOS-2 recorded higher AE and RT-57-1, RT-47-1, RT-67-3 and Kanchan showed greater PE. The RE and IUE were highest in RT-51-2 and NLST-3 respectively. Based on AE and IUE genotypes are classified as efficient and responsive (ER), non efficient and responsive (NER), efficient and non-responsive (ENR) and non-efficient and non-responsive (NENR). In this study ER genotypes were Mc Nair-12, RT-42-1, RT-67- 3 and RT-102-1. Genotypes including 16/103, CM-12, NLSH-1, NLST-3 and RT-90-1 are categorized as ENR. The genotypes viz., *Kanchan*, TOBIOS-2, RT-36-1, RT-47-1, RT-51-2, and RT-57-1 come under NER category. The NENR was represented by NLST-2, NLST-4 and RT-30-1. ER genotypes are to be selected while evolving the varieties for higher potassium use efficiency.

Key words: Potassium use efficiency, tobacco genotypes, effect and responsive, effect and non responsive

INTRODUCTION

Nutrients are essential for plant growth and development and required in large quantities because the available amounts are insufficient to meet the requirements of crop plants. Low nutrient use efficiency is the major problem in modern agriculture and its enhancement is very important both for reducing cost of agricultural production and for protecting environment. The exploitation of genotypic differences by selecting and identifying crop genotypes best adapted to the adverse soils with low nutrients is one of the key strategies for the sustainable intensification of agricultural systems (Balgiar *et al.*, 2001: Fagaria and Baligar, 1997).

Potassium is one of the macronutrient which plays vital role in plant growth for sustainable crop production (Marschner, 1995). Tobacco is known as luxury user of potassium. Among the different types of tobaccos, the export quality flue-cured tobacco grown in northern light soils requires fairly higher dose of potassium. As the flue-cured tobacco is sensitive to chloride, the source of potassium used is Sulphate of Potash (SOP) instead of muriate of potash. The sulphate of potash is very costly fertiliser. To reduce the use of costly potassium fertilizer SOP in tobacco, the promising strategy would be the identification and use of efficient and responsive tobacco genotypes to potassium. In the present study flue-cured tobacco varieties in vogue and the advanced breeding lines developed for NLS conditions were evaluated for potassium use efficiency.

MATERIALS AND METHODS

A Field experiment was conducted at CTRI Research Station, Jeelugumilli (17° 15' N, 81°08'E, 166 m above sea level) to evaluate FCV tobacco genotypes for their potassium use efficiency. Treatments for the field experiment included two levels of Potassium (0, 120 kg K_2O/ha) and eighteen flue-cured tobacco genotypes (16/103, Mc Nair-12, CM-12, Kanchan, NLSH-1, NLST-2, NLST-3, NLST-4, TOBIOS-2, RT-30-1, RT-36-1, RT-42-1, RT-47-1, RT-51-2, RT-57-1, RT-67-3, RT-90-1, RT-102-1) with three replications. The experimental field has acidic pH (5.6), low organic carbon (0.27%), high available P (27.5 mg kg^{-1}) and low available K (46 mg kg^{-1}). All plants received N and P @115 kg and 60 kg/ha respectively. The plants were grown using recommended package of practices. Plant samples @ 2 plants in each replication were collected at the age of 65 days. The plant parts (leaf, stem and root) were separated; oven dried and recorded the dry weights. The samples were processed and analyzed for K (Jackson, 1973). From the data potassium uptake, agronomic efficiency (AE), physiological efficiency (PE), recovery efficiency (RE) and internal use efficiency (IUE) were computed. IUE (Shoot biomass produce per unit K taken under K0 condition) is considered as efficiency and AE (Shoot biomass produced per additional K applied) dry matter produced is considered as responsiveness. Based on these two parameters genotypes were classified as efficient and responsive (ER), non efficient and responsive (NER), efficient and non responsive (ENR) and non-efficient and non responsive (NENR).

RESULTS AND DISCUSSION

Potassium stress caused significant reduction in biomass production recorded at 65 days after transplanting (DAT) in all the genotypes (Table 1). Among the genotypes highest shoot biomass is recorded in RT-51-2 followed by RT-57-1. Greater root biomass was recorded in CM-12 and Mc Nair-12. The reduction in shoot biomass among the genotypes varied from 8.65% to 34.77% due to the absence of potassium. The reduction in K uptake due to the absence of K varied from 37.58 to 64.48% among the genotypes. Highest K uptake is recorded in RT-52-2 followed by TOBIOS-2 and RT-57-1 (Table 2).

The Potassium use efficiency of genotypes is expressed as agronomic efficiency (AE), physiological efficiency (PE), recovery efficiency (RE) and internal use efficiency (IUE) (Table 3). There was wide variation in AE, PE, RE and IUE among the evaluated genotypes. Gurumurthy *et al* (2008), Nataraju *et al* (2002) and Janardhan *et al* (1996) also reported genetic variability among different tobacco varieties under southern transition zone of Karnataka. The genotype RT-51-2 recorded highest AE (3.7 kg kg^{-1}) followed by RT-57-1, TOBIOS-2, RT-42-1, RT-47-1, Mc Nair-12, Kanchan, RT-67-3, RT-102-1, RT-36-1, 16/103, RT-30-1, NLST-4, NLSH-1, RT-90-1, NLST-3, CM-12 and NLST-2 which ranged from 3.41 to 0.59 kg kg^{-1}). Physiological efficiency is maximum RT-57-1 (30.87 kg kg^{-1}) followed by RT-47-1, RT-42-1, Kanchan, RT-36-1, RT-67-3, TOBIOS-2, RT-51-2, Mc Nair-12, 16/103, RT-30-1, NLST-4, RT-102-1, NLSH-1, RT-90-1, NLST-3, CM-12. Recovery efficiency of 17.82% is recorded in RT-51-2 followed by TOBIOS-2, Mc Nair-12, RT-42-1, RT-102-1, NLSH-1, RT-67-3, 16/103, RT-57-1, RT-90-1, Kanchan, TOBIOS-2, RT-47-1, NLST-4, NLST-3, RT-36-1, CM-12 and NLST-2 which ranged from 14.93 to 6.24%. IUE is greater in NLST-3 followed by MC Nair-12, RT-102-1, CM-12, RT-67-3, RT-90-1, 16/103, NLSH-1, RT-42-1, TOBIOS-2, Kanchan, , NLST-4, RT-47-1, RT-30-1, NLST-2, RT-36-1, RT-57-1 and RT-51-2.

'Based on AE and IUE genotypes are classified as efficient and responsive (ER), non efficient and responsive (NER), efficient and non responsive (ENR) and non-efficient and non responsive (NENR). The categorization of genotypes is shown in Fig. 1. The efficient genotypes produced more biomass with the unit potassium taken from the soil and responsive genotypes produced more biomass with the applied potassium. In this study ER genotypes were RT-51-2, RT-57-1, TOBIOS-2, RT-67- 3 and RT-36-1. Genotypes NLST-4, NLST-3, RT-30-1, RT-90-1, NLSH-1 and CM-12 are categorized as ENR. The genotypes RT-42-1, Mc Nair-12, RT-47-1, Kanchan and RT-102- 1 come under NER category. The NENR genotypes were NLST-2 and 16/103. Genotypes which produce high biomass with low level of K and respond well to added K are the most desirable because they are able to express their high yield potential in a wide range of K availability. Hence ER genotypes are to be selected while evolving the varieties for higher potassium use efficiency.

Table 1: Effect of potassium on biomass production of different genotypes

Genotype	Shoot			Root			Total		
	K_{100}	K_0	Mean	K_{100}	K_0	Mean	K_{100}	K_0	Mean
16/103	915	654	785	241	148	195	1156	802	979
Mc Nair-12	1035	721	878	259	148	204	1294	869	1082
CM-12	881	792	837	246	195	221	1127	987	1057
Kanchan	1008	700	854	182	150	166	1190	850	1020
NLSH-1	1040	837	939	181	155	168	1221	992	1107
NLST-2	821	750	786	177	167	172	998	917	958
NLST-3	1017	887	952	227	150	189	1244	1037	1141
NLST-4	1165	935	1050	155	136	146	1320	1071	1196
TOBIOS-2	1185	804	995	190	123	157	1375	927	1151
RT-30-1	1088	848	968	179	162	171	1267	1010	1139
RT-36-1	1092	821	957	218	164	191	1310	985	1148
RT-42-1	1129	750	940	196	155	176	1325	905	1115
RT-47-1	1042	727	885	225	179	202	1267	906	1087
RT-51-2	1277	833	1055	229	186	208	1506	1019	1263
RT-57-1	1215	806	1011	208	179	194	1423	985	1204
RT-67-3	1142	838	990	227	202	215	1369	1040	1205
RT-90-1	1002	856	929	200	166	183	1202	1022	1112
RT-102-1	877	600	739	140	130	135	1017	730	874
	1052	787		204	161		1256	947	
	CD(0.05)			CD(0.05)			CD(0.05)		
Genotype (G)	110			38			122		
Potassium(K)	37			13			41		
G X K	NS			NS			NS		

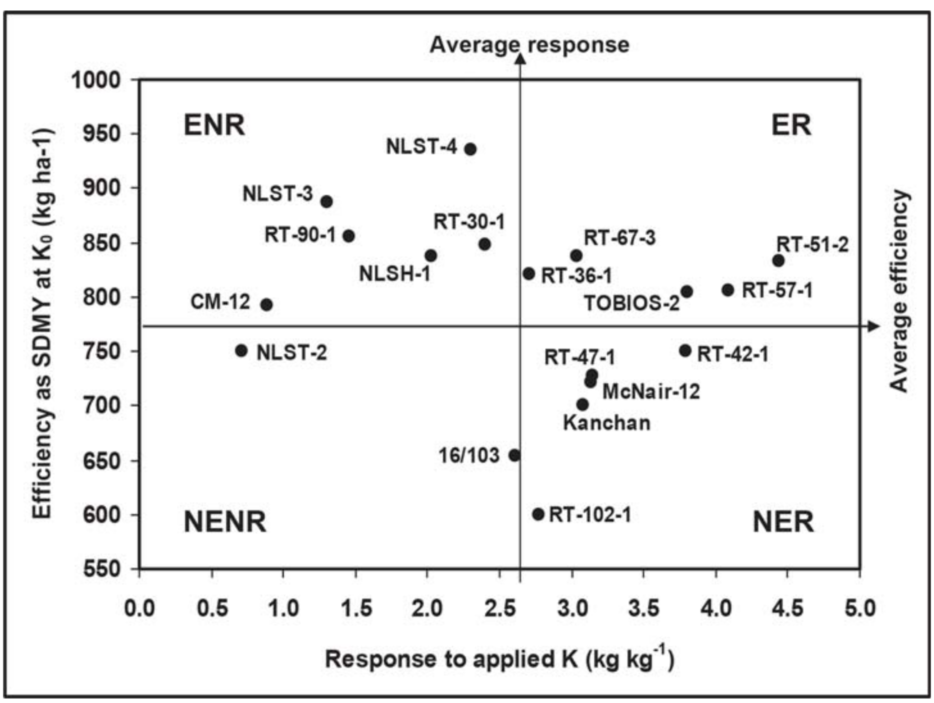
Table 2: Effect of potassium on K uptake (kg ha^{-1}) in different genotypes

Genotype	Potassium		
	K_{100}	K_0	Mean
16/103	22.21	8.84	15.53
Mc Nair-12	24.95	9.05	17.00
CM-12	21.36	10.44	15.90
Kanchan	23.51	10.68	17.10
NLSH-1	25.67	11.51	18.59
NLST-2	19.93	12.44	16.19
NLST-3	22.59	10.64	16.62
NLST-4	26.51	14.64	20.58
TOBIOS-2	29.69	11.78	20.74
RT-30-1	26.05	13.79	19.92
RT-36-1	25.38	13.92	19.65
RT-42-1	25.50	10.83	18.17
RT-47-1	23.62	11.50	17.56
RT-51-2	37.08	15.70	26.39
RT-57-1	28.07	14.82	21.45
RT-67-3	25.17	11.07	18.12
RT-90-1	24.60	11.37	17.99
RT-102-1	22.24	7.90	15.07
	25.23	11.72	
	CD(0.05)		
Genotype (G)	3.17		
Potassium(K)	1.06		
G X K	NS		

Table 3: Potassium use efficiency of different tobacco genotypes

Genotype	K Use efficiency			
	Agronomic efficiency(kg kg^{-1})	Physiological efficiency(kg kg^{-1})	Recovery efficiency(%)	Internal Use Efficiency(kg kg^{-1})
16/103	2.18	19.52	11.14	73.98
Mc Nair-12	2.62	19.75	13.25	79.67
CM-12	0.74	8.15	9.10	75.86
Kanchan	2.57	24.01	10.69	65.54
NLSH-1	1.69	14.34	11.80	72.72
NLST-2	0.59	9.48	6.24	60.29
NLST-3	1.08	10.88	9.96	83.36
NLST-4	1.92	19.38	9.89	63.87
TOBIOS-2	3.18	21.27	14.93	68.25
RT-30-1	2.00	19.58	10.22	61.49
RT-36-1	2.26	23.65	9.55	58.98
RT-42-1	3.16	25.84	12.23	69.25
RT-47-1	2.63	25.99	10.10	63.22
RT-51-2	3.70	20.77	17.82	53.06
RT-57-1	3.41	30.87	11.04	54.39
RT-67-3	2.53	21.56	11.75	75.70
RT-90-1	1.22	11.04	11.03	75.29
RT-102-1	2.31	19.32	11.95	75.95

Fig. 1: Grouping of flue-cured tobacco genotypes based on K efficiency and response to K application



REFERENCES

Baligar, V. C. , N. K. Fageria and Z. I. He. 2001. Nutrient use efficiency in plants. **Commun. Soil. Sci Plant. Anal.** 32:921-950

Fageria, N. K. and V. C. baligar. 1997. *Growth and Mineral Nutrition of Field crops*. 2nd edn. Marcel Dekkar Inc.

Gurumurthy, K. T., Vageesh, T. S. and Prakash, H. C. 2008. Potassium uptake efficieny and translocation Index of FCV tobacco varieties under southern transition zone of Karnataka. **Karnataka J. Agric. Sci.** 21(2):274-276

Jackson, M. L. 1967. *Soil Chemical analysis*. Prentice-Hall of India Pvt Ltd. New Delhi.

Janardhan, K. V., S. P. Nataraju, Y. V. Shetty, B. R. Murthy and R. Bhojaraja. 1996. Genetic variability and possible genetic improvement of potassium nutrition in FCV tobacco. **Tob. Res**. 22: 80-87.

Marschner, H. 1995. *Mineral Nutrition of Higher Plants*. Academic Press. San Diego, CA.

Nataraju, S. P, H. M. Jayadeva, K. V. Janardhan, and Ashoka. 2002. Screening of flue-cured tobacco genotypes for potassium uptake efficieny. **Karanataka J. Agric. Sci**. 15:18-23.