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BIOMASS RESIDUE /WOOD ASH AS POTENTIAL SUPPLEMENTS FOR POTASSIUM NUTRITION, YIELD AND QUALITY OF FCV TOBACCO IN KLS

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Flue Cured Virginia (FCV) tobacco is an important commercial crop grown under rainfed situation during Kharif (May-Sept) season in the Karnataka light soil (KLS) region of southern Transitional Zone in the Indian Peninsular Zone. Among the major plant nutrients, potassium is considered to be of considerable importance in influencing not only crop yields but more importantly the leaf quality and the bright grade production which influences the net reruns and profitability. The field experiments were conducted to assess the possibility of using various crop biomass residue/ wood ashes for supplementation of potassium in FCV tobacco cultivation in red sandy loam soils of KLS during 2013-14 to 2015-16. The various crop residues/wood ashes like Tobacco Stem Ash (TSA), Cotton Stem Ash (CSA), Pigeon Pea Stem Ash (PSA), and Eucalyptus Wood Ash (EWA) alone and in combination with SOP Fertilizer were evaluated for potassium supply, productivity, leaf quality and K uptake in FCV tobacco variety Kanchan. All the treatments supplied with ash or in combination with SOP produced significantly higher dry matter production compared to control (no K application), leaf productivity and the top grade equivalent. The application of various ashes alone or in combination with SOP did not markedly alter the cured leaf quality characters and were in the normal acceptable range. The cured leaf K content showed markedly significant higher K content in all the ash applied treatments. The post harvest soil analysis indicated higher available soil K status in the ash + SOP treatments compared to no K application or ash alone treatments. There is an ample scope for economizing the potassium cost input by integrating the various locally available crop residue/ wood/ barn ash along with SOP for sustaining the tobacco productivity and quality in the light soils of Karnataka.

INTRODUCTION

Among the major plant nutrients, potassium is considered to be of considerable importance in influencing not only the crop yields but more importantly the quality of FCV tobacco. As potassium plays a fundamental role in increasing the leaf size, color, yield and quality of FCV tobacco (Zehler et al., 1981; Krishnamurthy et al., 1993), the recommended dose of K_20 application is also high (120 kg/ha) compared to Nitrogen (60 kg / ha) or phosphorus (40 kg/ha). The known source of potassium supply through sulphate of potash (SOP) fertilizer is definitely superior to Muriate of potash (MOP) because of the low salt index (less than half of that of muriate of potash). On an average about 20-22% of the total SOP used in the country goes to tobacco farming. However the fertilizer SOP is not only costly but also scarce as the whole consumption of K fertilizer is imported. In this context alternative sources of K have promising future in the developing countries for sustaining the crop production. Naturally occurring K minerals (low-grade K minerals, silicate minerals and greensand) and indigenous sources of K (crop residue, manures, wood ash and seaweed) as well as K biofertilizer can be potential substitute of commercial K fertilizer for sustainable agriculture in the developing countries (Basak and Binoy Sarakar, 2017). While well prepared compost, wood ash, sea weed and its extracts, green sand, granite dust and host of other organic materials/minerals do serve as alternative sources of K, the availability at the local level, transportation of the large quantity due to their relatively low K content are the limiting factors in extensive use of these materials as substitutes for fertilizer SOP. In the present circumstances

Key words: FCV tobacco, KLS, Biomass ash/wood ash, potassium nutrition, productivity, quality

searching for alternative and cheaper sources of Potassium (which should be chlorine free) becomes very much important. Hence, locally available Agri waste or biomass residue of various crops which do not have much fodder value and are normally burnt for field clearing can be effectively used. The present investigations were carried out to find out the possibility of various biomass residue /wood ash as potential supplements for potassium nutrition, cured leaf productivity and quality of FCV tobacco grown under KLS conditions.

MATERIALS AND METHODS

The field experiments were conducted to assess the possibility of using various crop biomass residue/wood ashes for supplementation of potassium in FCV tobacco cultivation in red sandy loam soils of KLS during 2013-14 to 2015-16. The various crop residues/wood ashes like Tobacco Stem Ash (TSA), Cotton Stem Ash (CSA), Pigeon Pea Stem Ash (PSA), and Eucalyptus Wood Ash (EWA) alone and in combination with SOP Fertilizer were evaluated for potassium supply, productivity, leaf quality and K uptake in FCV tobacco variety Kanchan. The experimental soils were low in soil organic carbon, medium to high in available soil P and K status. The Experiment was conducted in Randomized Block Design with three replications and 10 treatments (Table 1). The recommended spacing of 100 x 55 cm with plot size of 33 m^2 (10 rows x 6 plants) and recommended N, $P_2 0_5$ and K_2O (60:40:120 kg/ha) nutrient dose adopted. N & P application was common to all the treatments, while in treatments T_5 to T_8, the respective ash & SOP were mixed in equal proportion (1 part of ash

Table 1: Treatment details

Tr. no.	Treatments (K Source)	% K	K applied rate(kg/ha)	Quantity applied (kg/ha)
1	Tobacco stem Ash (TSA)	16.0	100	625
2	Cotton Stem Ash (CSA)	20.5	100	490
3	Pigeon pea Stem Ash (PSA)	9.6	100	1040
4	Eucalyptus Wood Ash (EWA	3.5	100	2860
5	TSA+ SOP (1:1)	28.0	100	360
6	CSA+ SOP (1:1)	30.2	100	330
7	PSA+ SOP (1:1)	24.8	100	400
8	EWA+ SOP (1:1)	21.7	100	460
9	SOP	40.0	100	250
10	control	No K	0	0

Table 2: Total dry matter production, yield parameters and Cured leaf quality characters FCV tobacco as influenced by crop residue/biomass ashes in KLS conditions (mean of 3 years)

Treatments (K Source)	TDM kg/ha	CLY kg/ha	TGE kg/ha	Cured leaf quality 'X'			Cured leaf quality 'L'		
				nicotine	sugars	Chlorides	nicotine	sugars	Chlorides
Tobacco stem Ash (TSA)	1495	1296	913	1.37	16.28	0.31	2.23	15.45	0.32
Cotton Stem Ash (CSA)	1527	1321	928	1.48	17.77	0.36	2.00	17.41	0.33
Pigeon pea Stem Ash (PSA)	1470	1251	887	1.36	17.13	0.36	2.05	17.32	0.31
Eucalyptus Wood Ash (EWA	1468	1268	899	1.29	16.81	0.32	2.13	15.28	0.42
TSA+ SOP	1542	1371	967	1.31	18.60	0.34	1.86	17.06	0.37
CSA+ SOP	1571	1377	969	1.29	17.94	0.33	1.92	17.43	0.40
PSA+ SOP	1549	1328	934	1.29	18.39	0.33	1.85	17.30	0.41
EWA+ SOP	1477	1279	906	1.42	18.53	0.43	1.90	17.52	0.41
SOP alone	1626	1395	986	1.29	16.60	0.30	2.24	16.58	0.30
control	1289	1080	737	1.29	18.06	0.37	1.94	18.29	0.31
C.D.	75.9	70.8	60.1	NS	NS	NS	0.17	NS	NS

+ 1 par of SOP on material basis) and applied. The data on growth and yield parameters, K nutrient uptake, and cured leaf quality parameters were collected and analyzed and results interpreted.

RESULTS AND DISCUSSION

The data on the total dry matter production, yield parameters and cured leaf quality parameters as influenced by the ash and ash + SOP treatments are presented in Table 2. The total dry matter production was significantly influenced by the application of ash alone or ash in combination with SOP. All the treatments supplied with ash or ash in combination with SOP produced significantly higher dry matter production compared no K application. Application of cotton stem ash recorded higher dry matter followed by tobacco stem ash. In combination treatments also cotton stem ash + SOP treatments recorded higher plant dry matter. In general ash application in combination with SOP recorded higher plant dry matter compared to ash alone.

The productivity in terms of Cured leaf yield was significantly higher compared to the control in all the treatments. The treatments involving Cotton stem ash followed by tobacco stem ash in combination with SOP treatments recorded the productivity levels of both CLY and TGE on par with the 100% SOP treatment. Nwite et al. 2011 reported maize grain yield enhancement and improvement in most of the plant nutrients by the incorporation of rice husk ash and wood ash in southeastern Nigeria. All the ash treatments in combination with SOP were comparatively better compared to supply of entire potassium through ash alone for all the yield parameters. Higher top grade equivalent yields were recorded by tobacco stem ash and cotton stem ash in combination with SOP compared to other crop residue ash / wood ashes treatments.Ths may be due to the differences in the physical and chemical properties of the ash materials depending on the type of wood, combustion temperatures etc. (Campbell, 1990)

The cured leaf quality characters only marginally differed in different ash treatments. The application of ash alone or in combination with SOP did not markedly alter the cured leaf quality characters and were in the normal acceptable range

The data on the cured leaf K content in both X and L position of the plant, total k uptake by the crop and the soil nutrient status at the end of the crop season are presented in Table 3. The cured leaf K content showed markedly and significantly higher K content in all the treatments compared to no K application (Control).All the ash + SOP treatments recorded higher cured leaf K content than ash treatments alone in both X and L position. The total K uptake by the pant also followed similar trends with all the ash + SOP treatments recording

Table 3: Cured leaf K content, K uptake and post harvest soil nutrient status in FCV tobacco as influenced by crop residue/biomass ashes in KLS conditions

Treatments (K Source)	Cured Leaf K % in 'X'	Cured leaf K % in 'L	K uptake kg/ha	Organic carbon %	P_2O_5 kg/ha	K_2O kg/ha
Tobacco stem Ash (TSA)	1.81	1.59	45.4	0.28	69.1	281.6
Cotton Stem Ash (CSA)	1.67	1.56	47.1	0.30	68.6	284.0
Pigeon pea Stem Ash (PSA)	1.82	1.62	45.8	0.31	70.0	271.6
Eucalyptus Wood Ash (EWA	1.73	1.56	42.9	0.37	64.0	261.0
TSA+ SOP	1.91	1.79	51.2	0.30	73.3	506.0
CSA+ SOP	1.88	1.71	50.9	0.33	90.6	514.6
PSA+ SOP	1.96	1.68	52.9	0.30	82.6	465.0
EWA+ SOP	1.92	1.71	48.7	0.27	72.6	531.0
SOP	1.98	1.87	54.4	0.33	63.0	503.0
control	1.50	1.40	36.0	0.30	72.3	227.0
C.D.	0.26	0.16	4.06	NS	NS	96.3

the maximum values of K uptake. The post harvest soil analysis indicated higher soil available K status in the ash + SOP treatments compared to no K application or ash alone treatments.

The three year study indicated that there is vast scope for exploiting the crop residue ashes/ wood ashes for augmenting K supply, optimizing cured leaf productivity and enhancing leaf K content in FCV tobaccos grown especially in red sandy loam soils of KLS. Further there is an ample scope for economizing the potassium cost input by integrating the various locally available crop residue/ wood/barn ash along with SOP fertilizer for sustaining the tobacco productivity and quality in the light soils of Karnataka.

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