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EFFECT OF SOURCES, SPLIT AND FOLIAR APPLICATION OF KCL AND $KCLO_3$ ON AVAILABILITY POTASSIUM IN AEROBIC RICE

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ABSTRACT:

A field experiment was conducted in the sandy loam soil (*Fluventic Haplustept*) of Pandit Jawaharlal Nehru College of Agricult-ure and Research Institute, Karaikal, during *Kharif* 2015 to investigate the effect of KCl and $KClO_3$ as sources of potassium in aerobic rice with four types of split doses and two levels of foliar applications of potassium. The experiment was laid out in Randomised Block Design with three replications. As such, the treatments consisted of three factors *viz.*, sources, split and foliar applications. The rice variety PMK 4 was tested with two sources of potassium *viz.*, Potassium chloride (KCl) and Potassium chlorate ($KClO_3$), four types of split application *viz.*, K control (S_1), basal with no split (S_2), two splits (S_3) and three splits (S_4) along with foliar application treatments viz., no foliar (F_1) and foliar spray (F_2). The results of field experiment revealed that the growth parameters like plant height, leaf area index, number of tillers, productive tillers, dry matter production and root biomass were significantly influenced by sources, split and foliar application of potassium. Similarly, the yield components *viz.*, panicle length, panicle

weight, test weight, number of grains per panicle, number of spikelets per panicle, spikelet fertility, high density grains per panicle were also found to be significantly influenced by the sources, splits and foliar application of potassium.

On the whole, this investigation had revealed that $KClO_3$ could also be used as one of the sources of potassium for the growth and yield of aerobic rice. The application of potassium either through KCl or $KClO_3$ in three equal splits at basal, panicle initiation and flowering stages along with foliar application could be suggested as a strategy of potassium management for yield maximization in aerobic rice.

KEY WORD: *Effect of sources, Split and foliar application, KCl and $KClO_3$, Potassium, Aerobic rice.*

INTRODUCTION:

Rice gives life for major populations of the world and it is deeply embedded in the cultural heritage of societies. Rice is the staple food for about 50 % of the world`s populations that live in Asia. Rice is the second most important crop next to wheat in terms of area in the world and about 40 % of the world's population consumes rice as a major source of calorie to human kind (Banik, 1999). The increasing scarcity of water threatens the sustain ability of the irrigated rice production system and hence, the security and livelihood of rice producers and consumers are in question. Several strategies for water saving were developed in recent years, to increase water productivity and reduce water losses in the rice system. The concept of aerobic rice was first developed in China during mid-1980. The term "Aerobic rice" was coined by International Rice Research Institute (IRRI). Aerobic rice cultivation will curb methane production and saves water without affecting the productivity. It is the time to save water from the irrigated system of rice cultivation by adapting the aerobic rice cultivation. This technology is a better remedy for future climate change under drought condition with lesser greenhouse gas emission.

MATERIALS AND METHODS:

The three factor experiment was conducted in Randomized Block Design (RBD) with three replications in the east farm of Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal during the year of 2015.The factor I includes two sources of potassium kcl (k_1) and $kclo_3$ (k_2), factor II includes split doses of potassium like S_1 - K control; S_2 - K as basal (15 DAS) without split; S_3 - K in two splits (Basal & Panicle initiation stages); S_4 - K in three splits (Basal, Panicle initiation & Flowering stages) and factor III includes Foliar spray (2%) - F_1 - Without foliar spray; F_2 - With foliar spray (2 times at Active tillering & P Panicle initiation stages). The blanket recommendation of 150:50:50 kg N, P_2O_5 and K_2O ha^{-1}, adopted for aerobic rice was followed in this investigation**.** Nitrogen and phosphorus were applied through urea and super phosphate respectively to meet the blanket recommendation. Potassium was applied through the sources of KCl and $KClO_3$ as per the treatment structure. The availability of potassium was determined by Flame photometric method using neutral normal Ammonium acetate method given by Stan- ford and English (1949).

RESULTS:

Available Potassium at different stage of crop growth

At active tillering stage

Potassium availability at active tiller- ng stage was greatly influenced by the split application of potassium alone in the main factors (Table 1). The maximum available K was registered in three split applications (297 kg ha^{-1}), which was followed by two splits (269 kg ha^{-1}), basal with no split (263 kg ha^{-1}) and control treatment (239 kg ha^{-1}). All the splits performed equally in maintaining the available potassium status in the soil sequentially one with the other at this stage.

At panicle initiation stage

The available K status at this stage (Table 1) was found to be significant with sources and split and the interaction effect of source with split application of potassium. The potassium chloride showed its markable performance in maintaining the available potassium (246 kg ha^{-1}), which was significantly superior over the performance of potassium chlorate.

Among the split applications studied, the two split application recorded higher available K (263 kg ha^{-1}) and showed its supremacy in keeping the available K status of the soil at this stage. Secondly, the three splits (236 kg ha^{-1}) showed its better performance than basal and K control treatment.

In the case of interaction effect of source and split application of potassium, the potassium chloride with two splits registered higher available K (287 kg ha^{-1}), which was closely followed by three splits of the same source (262 kg ha^{-1}). Both the sources in the control treatment and potassium chloride in basal application were equal in their effect by establishing the available K in soil at this stage. Moreover, the potassium chloride as basal without split and potassium chlorate in three splits registered the same level of potassium (210 kg ha^{-1}) at this stage.

At flowering stage

The soil available K at this stage (Table 2) also was found to be significantly influenced by the sources, split and their interactions. In the case of sources, potassium chloride provided higher amount of K to soil (227 kg ha^{-1}) than potassium chlorate, which could be able to provide only 208 kg ha^{-1} of potassium to soil.

Among the splits, the higher available K was registered in two and three splits with the available K status of 234 kg ha^{-1} and 232 kg ha^{-1} respectively. At the same time, the control and basal splits performed equal in maintaing the K level of potassium in soil.

With respect to interaction effect of source and split application of potassium, the potassium chloride with two splits showed its superiority with 263 kg K ha^{-1} over the other interaction effects. But it was closely followed by three splits (252 kg ha^{-1}) of the same KCl. Both the sources in control and basal treatment performed equally in keeping the available potassium in soil, ranging from 192 to 215 kg ha^{-1}.

At post-harvest

The effect of split application was phenomenally seen in keeping the available K in soil at post-harvest (Table 2). The three split application recorded higher available K (197 kg ha^{-1}), which was on par with the two split application (190 kg ha^{-1}). The lower available K was recorded (164 kg ha^{-1}) in control treatment.

In the case of sources and split application of potassium, the potassium chloride with three splits showed the highest available potassium (206 kg ha^{-1}) in soil independently over the other interaction effects. Within the other interactions, both the sources in two splits showed equal effect in the availability of potassium in soil. Further perusal of the results revealed that the potassium chlorate as basal without split and through three splits maintained almost the same level of 183 kg ha^{-1} and187 kg ha^{-1} of available potassium in soil respectively. The lowest available potassium of 173kgha^{-1} was observed in K control of potassium chloride.

DISCUSSION AND CONCLUSION:

In the case of sources, the higher K availability was found with the potassium chloride in panicle initiation and flowering stages of crop growth and this may be due to the dissociation pattern of KCl, which seems to be faster than $KClO_3$.

In the split doses of potassium, the two and three splits maintained more availability of K in soil in almost all the stages (Fig. 1). It is due to the continuous sup- ply of potassium in all active growth stages through split application. It was proved by many authors viz., Annadurai *et al.* (2000); Pal *et al.* (2000); Yadav *et al.* (2004); Manzo or *et al.* (2008) and Sivagnanam *et al.* (2015).

Within the interaction of source and split applications, the potassium chloride with two and three split recorded higher availability of K in soil than the potassium chlorate. This could be ascribed due to the combined effect of source and split application, as described in the above discussion.

The KCl recorded higher available K at panicle initiation and flowering stages. The three split doses of potassium enhanced the available K at active tillering and harvest stages. Whereas, the two splits recorded high- er available K at panicle initiation and flowering stages of crop growth in aerobic rice

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Table 1: Available potassium (kg ha^{-1}) at active tillering and panicle initiation stages

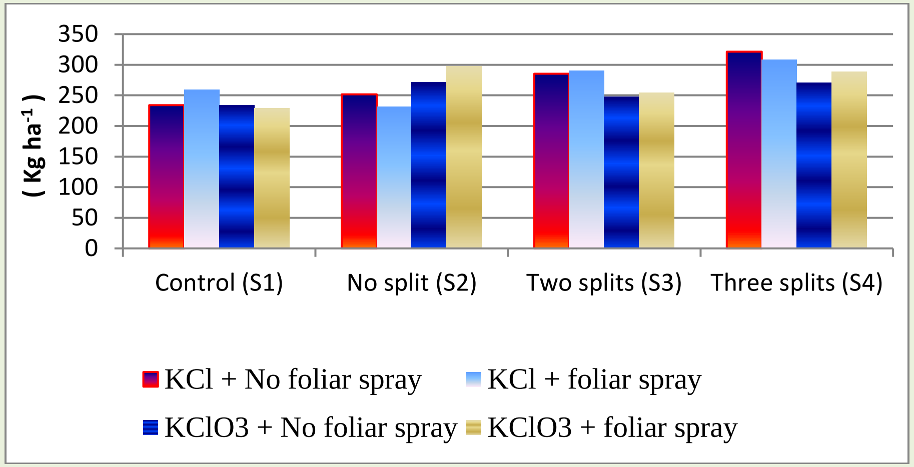
	ACTIVE TILLERING STAGE							**PANICLE INITIATION STAGE**						
	S_1	**S_2**	**S_3**	**S_4**	**K_1**	**K_2**	**Mean**	**S_1**	**S_2**	**S_3**	**S_4**	**K_1**	**K_2**	**Mean**
K_1F_1	**234**	**251**	**285**	**321**	**-**	**-**	**-**	**234**	**231**	**265**	**281**	**-**	**-**	**-**
K_1F_2	**259**	**231**	**290**	**308**	**-**	**-**	**-**	**216**	**190**	**309**	**243**	**-**	**-**	**-**
K_2F_1	**234**	**271**	**248**	**270**	**-**	**-**	**-**	**195**	**242**	**232**	**190**	**-**	**-**	**-**
K_2F_2	**229**	**297**	**254**	**288**	**-**	**-**	**-**	**194**	**263**	**247**	**231**	**-**	**-**	**-**
K_1 - KCl	**246**	**241**	**287**	**314**	**-**	**-**	**-**	**225**	**210**	**287**	**262**	**-**	**-**	**-**
K_2 - $KClO_3$	**231**	**284**	**251**	**279**	**-**	**-**	**-**	**194**	**252**	**239**	**210**	**-**	**-**	**-**
F_1	**234**	**261**	**266**	**296**	**273**	**256**	**264**	**214**	**236**	**248**	**235**	**253**	**214**	**233**
F_2	**244**	**264**	**272**	**298**	**272**	**267**	**269**	**205**	**226**	**278**	**237**	**239**	**234**	**236**
Mean	**239**	**263**	**269**	**297**	**272**	**261**	**-**	**209**	**231**	**263**	**236**	**246**	**224**	**-**

Sources	**S.Ed.**	**C.D. (p = 0.05)**	**S.Ed.**	**C.D. (p = 0.05)**
K sources (K)	**12.067**	***NS***	**9.877**	**17.0**
Split application	**17.065**	**29.0**	**13.968**	**24.0**
Foliar application	**12.067**	***NS***	**9.877**	***NS***
K x S	**24.134**	***NS***	**19.753**	**34.0**
K x F	**17.065**	***NS***	**13.968**	***NS***
S x F	**24.134**	***NS***	**19.753**	***NS***
K x S x F	**34.130**	***NS***	**27.936**	***NS***

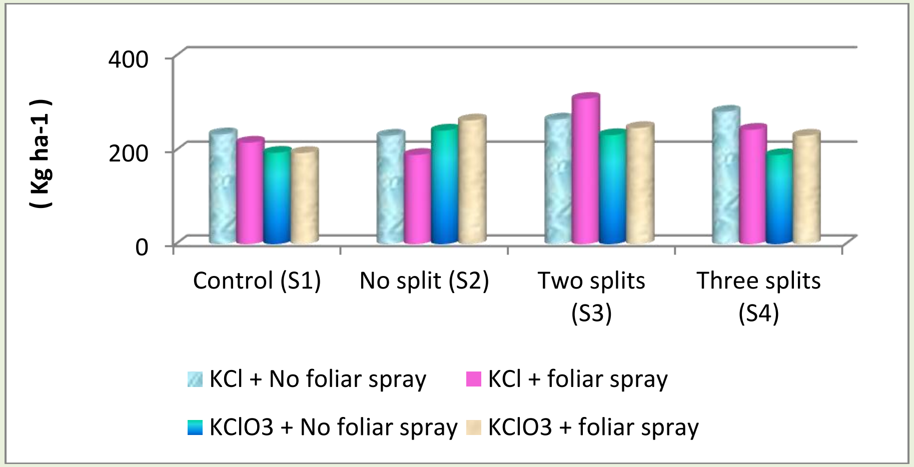
Table 2: Available potassium (kg ha^{-1}) at flowering and harvest stages

	FLOWERING STAGE							**HARVEST STAGE**						
	S_1	**S_2**	**S_3**	**S_4**	**K_1**	**K_2**	**Mean**	**S_1**	**S_2**	**S_3**	**S_4**	**K_1**	**K_2**	**Mean**
K_1F_1	**188**	**203**	**265**	**273**	**-**	**-**	**-**	**167**	**172**	**201**	**214**	**-**	**-**	**-**
K_1F_2	**197**	**201**	**260**	**232**	**-**	**-**	**-**	**180**	**165**	**187**	**198**	**-**	**-**	**-**
K_2F_1	**192**	**217**	**198**	**207**	**-**	**-**	**-**	**156**	**183**	**187**	**182**	**-**	**-**	**-**
K_2F_2	**205**	**213**	**214**	**217**	**-**	**-**	**-**	**153**	**183**	**187**	**193**	**-**	**-**	**-**
K_1 - KCl	**192**	**202**	**263**	**252**	**-**	**-**	**-**	**173**	**168**	**194**	**206**	**-**	**-**	**-**
K_2 - $KClO_3$	**198**	**215**	**206**	**212**	**-**	**-**	**-**	**155**	**183**	**187**	**187**	**-**	**-**	**-**
F_1	**190**	**210**	**231**	**240**	**232**	**203**	**218**	**162**	**177**	**194**	**198**	**188**	**177**	**183**
F_2	**201**	**207**	**237**	**224**	**222**	**212**	**217**	**166**	**174**	**187**	**195**	**182**	**179**	**181**
Mean	**195**	**209**	**234**	**232**	**227**	**208**	**-**	**164**	**176**	**190**	**197**	**185**	**178**	**-**

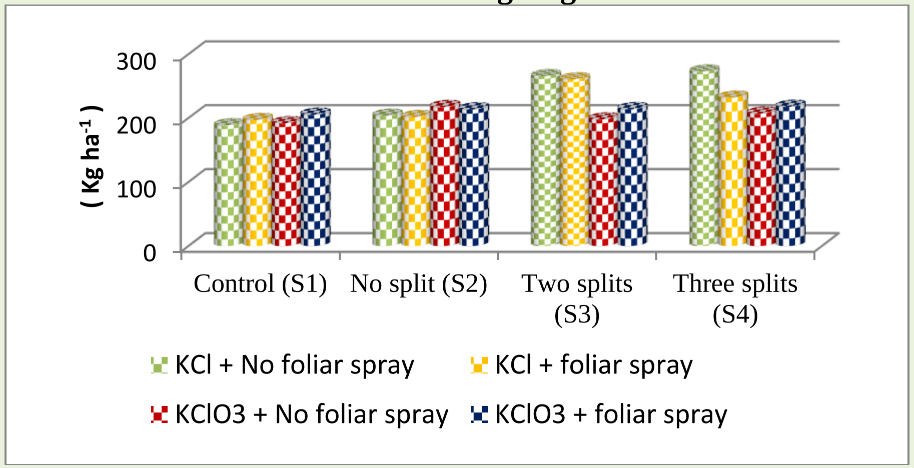
Sources	**S.Ed.**	**C.D. (p = 0.05)**	**S.Ed.**	**C.D. (p = 0.05)**
K sources (K)	**7.624**	**13.0**	**3.879**	***NS***
Split application	**10.782**	**18.0**	**5.485**	**9.0**
Foliar application	**7.624**	***NS***	**3.879**	***NS***
K x S	**15.248**	**26.0**	**7.757**	**13.0**
K x F	**10.782**	***NS***	**5.485**	***NS***
S x F	**15.248**	***NS***	**7.757**	***NS***
K x S x F	**21.564**	***NS***	**10.971**	***NS***



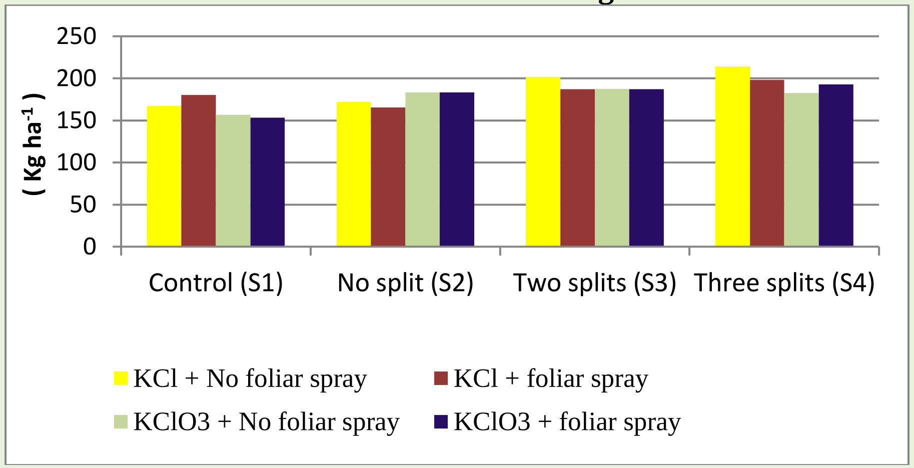
Active tillering stage



Panicle initiation stage



Flowering stage



Harvest stage

Fig. 1. Available potassium at different stages