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Escalation in Rice (*Oryza sativa* L.) Seed Strength and Successive Development through Sustainable Application of Potassium Humate

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ABSTRACT

Seed strength is an important agronomic traits and considered as an indicator of crop yield and economic value. Different concentrations of Potassium humate i.e. 0, 250, 500, 750 and 100 mg per Kilogram were applied on the seeds of Basmati rice and their influence was observed. After treatment with the Potassium humate various vegetative (plant height; root, shoot length; fresh and dry biomass of root and shoot) and reproductive growth (number of tillers, flowers, grains, weight of 100 grains) parameters were recorded. It was observed that 500 mg/Kg concentration of potassium humate has given potential results as compared to rest of the concentrations. It was also observed that an increment in the concentration from 500mg/Kg has ceased numbers of physiological functions of the rice plants under trial.

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INTRODUCTION

Humic acid is a plant growth bio-stimulant which acts like a hormone; it helps in growth promotion of the crop plants as well as in strengthens their potential to withstand any type of biotic or a-biotic stress. (Serenella *et al.,* 2002). It increases seed vigor, germination (Turkmen *et al.,* 2004), biomass of plant, crop yields and quality (Serenella *et al.,* 2002). Humic acid increases water stress resistance and drought tolerance in plants (Zhang *et al.,* 2003), and keeps fertilizer from leaching through the soil, Chelates and enhances availability of nutrients to plant and in this way enhances nutrient uptake (Serenella *et al.,* 2002). Instead of all this its higher concentration in soil reduces plant growth and yield (Dursun *et al.,* 2002). Potassium humate can trigger the physiological functions of the plant and can be a source of humic acid. Zaghloul *et al.,* 2009 discussed that after the treatment of crop with different concentrations of potassium humate a very significant and visibly positive fashion of growth was observed. Agronomic traits i.e. plant height, stem diameter, root length etc. were studied in this experiment.

Rice is an integral cereal crop not only in Pakistan but also in whole of the world. About two third of world's population consumes rice as a staple food (Dowling *et al.,* 1998). Even though the rice is second most widely grown cereal crop after wheat but is the largest irrigated crop in the world (Roel *et al.,* 1999). About 80 million irrigated land of Asia is reported to produce 75% of the world's rice supply. As far as concern about Pakistan, its rice cultivation and consumption mostly centralized in Punjab and Sindh provinces (Tabal *et al.,* 2002). In Punjab province an area starting from the outer peripheries of Lahore moving towards Narowal, Sialkot, Gujranwala and some areas of Sheikhupura is known as rice belt. This area is well known geographical belt famous for rice cultivation. This study was aimed at accessing vegetative and reproductive growth of rice under the effect of different concentrations of potassium humate in order to recommend a potential dose for this purpose.

METHODS AND MATERIAL

Basmati rice seeds were acquired from Rice Research Station, Kala Sha Kaku. Sterilized seeds with 0.5% NaOCl solution were checked for seed vigor and seedling growth in lab at 25 ± 2°C temperature, against different concentrations {0 (control) , 250 (T1), 500 (T2), 750 (T3) and 1000 (T4) mg/L} of potassium humate. Three ml of all concentration were applied in 5 sets with three replicates. Two ml of Murashige Skoog medium (Dahleen & Bregitzer, 2002) was also applied in every Petri plate for nutrient supply. Different parameters of seedling growth (percentage germination, seedling length, fresh and dry weight of seedling, root and shoot length) were recorded after ten days, in lab experiment.

Field experiment was performed in open environment at the temperature of 25-40°C. It consisted of control (without potassium humate) and treatments (T1, T2, T3 and T4 having 250, 500, 750 and 1000 mg/Kg soil respectively) all having 3 replicates with 5 pots per replicate (1 plant/pot). The pots which were filled with pebbles free silt having the size of 8/12" and two Kilogram of soil was added to each pot. Soil samples were also sent to Soil and Water Testing laboratory, department of Agriculture, Government of the Punjab, Thokar Niaz Baig, Lahore.

The hawing of pots was performed after an interval of 7 days. Three seedlings of one month were transferred to every pot and thinning was performed after 2 weeks allowing seedling of rice to stabilize. Irrigation was done regularly in the morning. At the time of harvest i.e., after 60 & 120 days of sowing, one plant from every replicate was carefully uprooted and was processed for the study of different parameters. After measuring plant height, shoot and root length and fresh weight the shoots and roots of cultivated plants were dried in hot air oven at 80±1 °C for 24 h. At second harvest total yield of control and all treatments was analyzed by recording the number of tillers, flowers, grains and weight of grains per plant and weight of 100 grains of every treatment.

RESULTS AND DISCUSSION

Lab experiment

The results calculated for the rice seedling, in lab experiment, variable treatments of potassium humate have shown significant effect of growth, health, viability and growth of rice seeds (Table 1). Seed vigor and all parameters of seedling growth were seen directly proportional to the concentration of potassium humate (Serenella *et al.,* 2002). Maximum values of seed percentage germination, seedling length, fresh weight of seedling, shoot length and root length were recorded in T4 with 1000mg/L concentration. While minimum values were recorded in control. Dry weight of seedling also increased with increase in the concentration upto 500mg/L but later on it decreased in higher concentrations (Dursun *et al.,* 2002).

Table 1. Seed germination and seedling growth of rice at different concentrations of Potassium humate in lab experiment.

Treatments	Percentage germination (%)	Seedling			Shoot length (cm)	Root length (cm)
		Length (cm)	Fresh weight (g)	Dry weight (g)		
Control	73.33ab	7.3c	0.0316bc	0.00023c	3.57b	3.73bc
T1	83.33a	7.89b	0.0348b	0.0004b	3.75b	4.14b
T2	86.67a	8.25ab	0.0361b	0.00057a	3.87ab	4.38ab
T3	86.67a	9.04a	0.0389b	0.0005ab	4.22a	4.82a
T4	86.67a	9.147a	0.0413a	0.00043b	4.23a	4.91a

Field experiment

Vegetative growth

Enhancement in rice growth, introduced by potassium humate, was also observed in the field experiment. The results obtained from the application of different concentrations of potassium humate in field experiment indicated that it supported the different parameters of plant (Serenella *et al.,* 2002; Tűrkmen *et al.,* 2004). The increase in plant growth was observed with high concentration of potassium humate i.e. 500 mg/kg (T2) while further addition of potassium humate seem to cease the vegetative growth of rice (Dursun *et al.,* 2002). All vegetative growth parameters including plant height (Figure 1), shoot growth (length, fresh & dry biomass) and root growth (length, fresh & dry biomass) showed best results in T2. The results are depicted in Table 2.

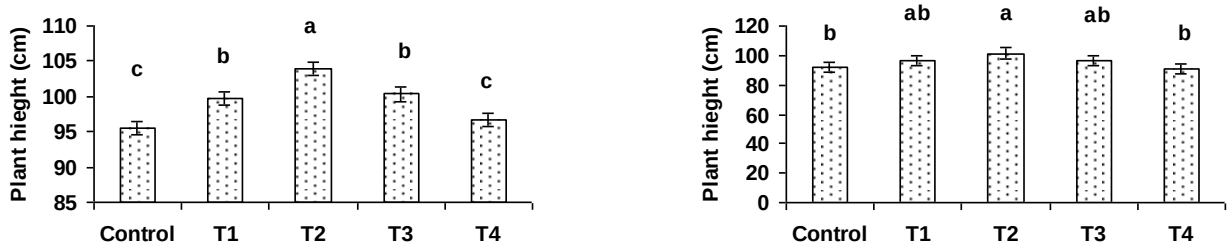

Figure 1. Effect of potassium humate on plant height of rice in field experiment (1st & 2nd harvest)
Values with different letters show significant difference (P=0.05) as determined by DMR test.
Vertical bars show Standard errors of mean as 5 replicates.

Table 2. Different Shoot and Root growth parameters of Rice in field experiment.

Vegetative growth	Harvest	Control	T1	T2	T3	T4
Shoot parameters						
Length (cm)	1st	66.87c	70.18b	73.51a	69.76b	60.02c
	2nd	70.71c	73.73b	76.76a	75.02ab	73.26bc
Fresh weight (g)	1st	34.51c	43.30b	51.12a	45.27b	37.02bc
	2nd	45.11b	49.32ab	53.52a	48.86ab	45.63b
Dry weight (g)	1st	16.40bc	17.94ab	19.26a	16.73b	14.19c
	2nd	16.62c	20.63b	24.86a	23.97a	23.09ab
Root parameters						
Length (cm)	1st	25.10a	26.44a	27.78a	26.2a	24.62a
	2nd	24.76ab	25.97a	27.17a	25.31ab	23.43b
Fresh weight (g)	1st	6.29c	7.41ab	8.54a	7.59ab	6.64b
	2nd	7.85bc	9.81b	11.76a	10.22b	8.67bc
Dry weight (g)	1st	3.94bc	4.69b	5.45a	4.64b	3.84c
	2nd	4.32c	5.23b	6.13a	5.15b	4.18c

Reproductive growth

This research work has observed the effect of potassium humate concentrations of yield of rice viz., tiller numbers, fresh and dry weight of 100 grains and flowers were studied (Figure 2) The data obtained from field experiment indicated that number of tillers increased significantly with increase in concentration of potassium humate. Potassium humate induced higher number of flowers and grains production in rice than control (Tűrkmen *et al.,* 2004); however, its higher concentration ceased the increase in yield (Dursun *et al.,* 2002). The Data regarding dry weight of 100 rice grains show remarkable difference on statistical analysis. The yield of rice increased with increase in concentration of potassium humate upto T2 (500mg/Kg) which showed maximum yield, while further increase in concentration retarded the yield.

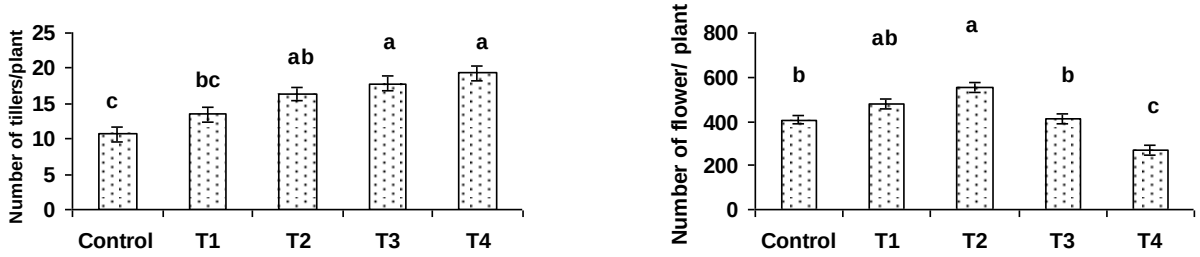

Figure 2 (a,b). Effect of potassium humate on reproductive growth of rice growth in field experiment.
a= Number of tillers per plant b= Number of flowers per plant

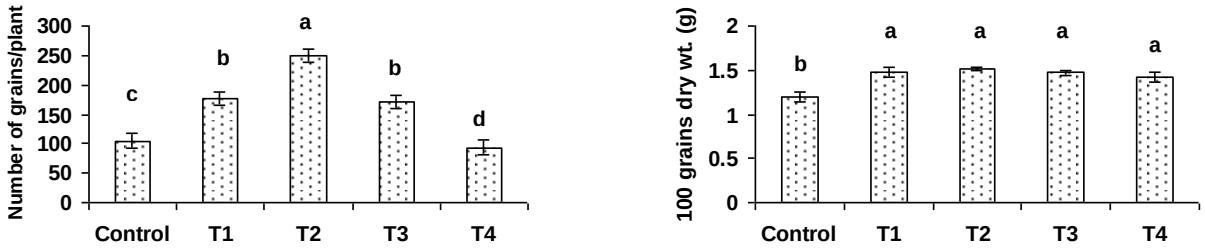

Figure 2 (c,d). Effect of potassium humate on reproductive growth of rice growth in field experiment.
c= Number of grains per plant c= Weight of 100 grains (gram)
Values with different letters show significant difference (P=0.05) as determined by DMR test.
Vertical bars show Standard errors of mean as 5 replicates.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

AUTHORS CONTRIBUTIONS

All the authors contributed equally to this work.

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