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RESEARCH PAPER

Effect of foliar spray of growth regulators with nutrients on yield variation in varagu under rainfed condition

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Abstract : A study was conducted in the Centre of Excellence in millets, Athiyandal, Tiruvannamalai district during *Kharif'* (September, 2015-January, 2016). Scarcity of water is a severe environmental constraint to plant productivity. Millets are small-seeded grasses that are hardy and grow well in dry zones as rain-fed crops, under marginal conditions of soil fertility and moisture. This is important in heavily populated areas. The experiment was conducted by adopting Randomized Block Design with three replications. The morpho and physiological effects were positively correlated with yield components in varagu under rainfed condition. Growth regulator and nutrient spray on the crop growth period had significant influence on the plant height, relative water content, number leaves and yield component of the plant under rainfed condition.

Key Words : Growth regulator, Plant height, No. of leaves, RWC (%), Yield, Water stress

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INTRODUCTION

Millets represent small grain crops but more nutritional grains that are mainly cultivated in marginal environments. Short life-cycle of millets assists in escaping from stress as they require 12–14 weeks to complete their life-cycle (seed to seed) whereas rice and wheat requires a maximum of 20–24 weeks. However, the prevalence of stress conditions and their consequences are circumvented by several traits such as short stature, small leaf area, thickened cell walls, and the capability to form dense root system (Li and Brutnell, 2011). Small millets are similar to maize and sorghum, millets possess a C4 photosynthesis system; hence, they prevent photorespiration. These C4 mechanisms efficiently utilize the scarce moisture present in the semi-arid regions. Since C4 plants are able to close their stomata for long periods, they can significantly reduce moisture loss through the leaves. Drought stress reduces leaf size, stems extension and root proliferation, disturbs plant water relations and reduces water use efficiency. Plants display a variety of physiological and biochemical responses at cellular and whole-organism levels towards prevailing drought stress, thus making it a complex phenominon. Small millets - a group of six crops / minor coarse cereals, namely finger millet *(Eleusine coracana)*, little millet *(Panicum miliare)*, kodo millet *(Paspalum scrobiculatum)*, foxtail millet

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(Setaria italica), barnyard millet *(Echniochola frumentacea)* and proso millet *(Panicum miliaceum)*, representing the area grown in that order. These crops have traditionally been the indispensable component of dry farming system. Small millets are more nutritious compared to fine cereals. They are rich in micronutrients and extremely resilient in the face of drought and other abiotic stresses, making them valuable food security crops for millions living in marginal environments. The millet grain contains about 65% carbohydrate, a high proportion of which is in the form of non starchy polysaccharides and dietary fibre which help in prevention of constipation, lowering of blood cholesterol and slow release of glucose to the blood stream during digest. Millet grains are also rich in important vitamins *viz*., thiamine, riboflavin, folin and niacin.

Small millet species namely, kodo, finger, proso, foxtail, little and pearl millets; were shown to have an anti-proliferative property and have a potential in the prevention of cancer initiation. The anti-proliferative property of these millets is associated with the presence of phenolic extracts. Among the six small millets indicated above, the maximum phenolic content was obtained in kodo millet while the minimum was in foxtail millet. Brassinosteroid is a novel plant growth promoting steroidal lactone which is the most biologically active compound and acting as bioregulators in crop plants. Brassinosteroid enhances cell division, cell elongation and also cell differentiation (Mitchell and Gregory, 1972). It promotes the polymerase activities of RNA and DNA and their replication, transcription and translation. It increases proton pump action and regulates plant metabolism for improved growth. Homobrassinolide enhanced the photosynthetic efficiency of the leaves and also mobilization of metabolites to the reproductive sinks, thus increasing the yield in mungbean (Bhatia and Kaur, 1997). Bindhu Joseph (2000) recorded an increased yield in groundnut by the foliar application of BR. Senthil *et al*. (2003) reported that foliar spray of 0.5 ppm BR increased the chlorophyll content in soybean.

Plants absorb iron from the soil in both Fe^{2+} and Fe^{3+} forms. Iron is a constituent of cytochromes, ferredoxin, catalase, peroxidase, ferrichrome etc. In cells, most of the iron is present in the chloroplasts. It is required in chlorophyll synthesis. Urea is one of the nitrogenous fertilizers which is having 46 % primary nutrient, nitrogen (N). It is an essential component of proteins, protoplasm and chlorophyll. In addition, N is a consitituent of purine, pyrimidine, porpyrins and coenzymes. The propyrin structure contains N which is found in some metabolically important compounds such as the chlorophyll pigments and the cytochromes essential for photosynthesis and respiration, respectively. Spray of N significantly increased the number of pods and seed yield of greengram (Yakadri *et al.*, 2002).

Growth and yield of a varagu plant is drastically affected directly or indirectly by altering metabolism, growth and development. Prolonged water shortages virtually affect all the metabolic processes and often result in severe reductions in plant productivity (Hare *et al*., 1998). Salicylic Acid (SA) belongs to the group of plant phenolics. Thus, the SA is a secondary metabolite acting as analogue of growth regulating substances. It helps in the protection of nucleic acids and prevention of protein degradation. The SA is found in all plant species and highest level was observed in the inflorescence of thermogenic plants and plants infected with necrotizing pathogens (Raskin, 1992). The SA helps in the thermogenesis and resistance of plants (Davies, 1988). The SA is also known to induce many genes coding for pathogenesis-related proteins in response to biotic and abiotic stresses (Enyedi *et al.*, 1992 and Yalpani *et al.*, 1994). The detrimental impact of drought on varagu crop can be minimized by developing drought- tolerant genotypes. Drought tolerance is a complex mechanism that is influenced by a wide range of physiological traits which have some relationship with productivity under water deficit conditions. Development pattern in Kodo millet is an important aspect, as the phenological characters *viz.*, number of leaves, rate of flowering vary with the genotypes. The study of growth analysis would help in understanding contributions of various growth processes in accumulation of dry matter and yield (Channappagoudar *et al*., 2008). Drought tolerance is a complex physiological trait with multigenic components, which interact in a holistic manner in the plant systems (Ingram and Bartels, 1996; Cushman and Bohnert, 2000). The factors influencing growth and development of crop plants are to be integrated at an optimum level for maximum production potential.

MATERIAL AND METHODS

A field experiment was conducted at Centre of Excellence in millets, Athiyandal, Tiruvannamalai district during *Kharif*' (September, 2015-January, 2016). The experiment was laid out in a Randomized Block Design and replicated thrice. Duration of the crop was 120 days. Varagu variety CO3 was sown with a spacing of 45 cm x 10 cm and raised following recommended package of practices. Plant height, root length and number of leaves were recorded at vegetative, panicle initiation and grain filling stage. Bio-regulators like brassinosteroid (BR), salicylic acid (SA) and fertilizers / chemicals such as urea, ferrous sulphate ($FeSO_4$) and potassium chloride (KCl) were used in this study.

T_1-Control

T_2-Water spray

T_3-1 % KCl spray

T_4-0.1 ppm brassinosteroid spray

T_5-100 ppm salicylic acid spray

T_6-0.1% PPFM spray

T_7-0.5% $FeSO_4$+ 0.5% urea spray

T_8-100 ppm salicylic acid+0.5% $FeSO_4$+ 0.5% urea spray

T_9-1 % KCl+100 ppm salicylic acid+0.5% $FeSO_4$+ 0.5% urea spray

T_{10}-1 % KCl+0.1 ppm brassinosteroid +0.5% $FeSO_4$+ 0.5% urea spray.

Time of sprays:

First spray at Active tillering stage, second spray at panicle initiation stage.

Results and Discussion

The first and foremost effect of drought is impaired germination and poor stand establishment. Drought stress has been reported to severely reduce germination and seedling stand. The comparison of plant height at various stages of crop growth is a measure of assessing the vigour due to the rainfed condition. There was a steep increase in plant height and root length over time from vegetative to maturity stage. Taller plants were observed with 1 % KCl+100 ppm salicylic acid+0.5% $FeSO_4$+ 0.5% urea spray (T_9) (Table 1). The significant increase in root length may partially be attributed to increased cell division and elongation which in turn, helped in better development of root system (Lakshmamma and Subha Rao, 1996). The dry matter accumulation of millet increased upto 110 days after emergence in varagu under rainfed condition (Begum *et al.*, 2013). The productivity of little millet was found to be dependent on

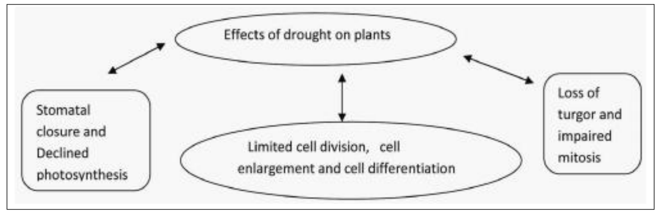

Fig. 1 : Description of possible mechanisms of growth reduction under drought stress

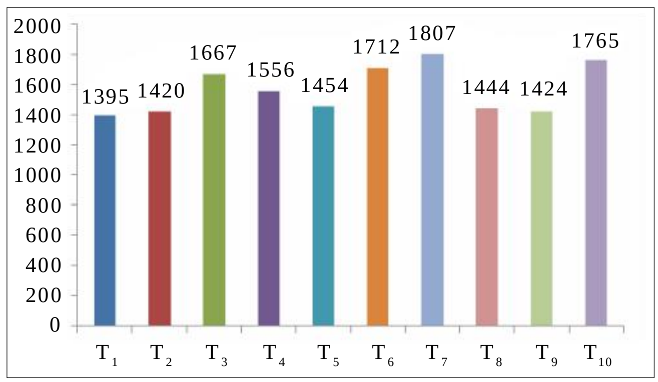

Fig. 2 : Impact of foliar spray of nutrients with growth regulators on grain yield (kg/ha) in varagu

Table 1 : Impact of foliar spray of nutrients with growth regulators on plant height, relative water content, no. of leaves and yield components in varagu

Treatments	Plant height (cm)	RWC (%)	No. of leaves $plant^{-1}$	TDMA (kg ha^{-1})	1000 grain weight (g)	Grain yield (kg/ha)
T_1	50.83	74	19	3420	5.89	1395
T_2	59.00	79	23	4320	5.09	1420
T_3	52.67	79	26	5130	5.96	1667
T_4	50.83	81	18	4680	5.37	1556
T_5	53.17	84	30	4940	6.55	1454
T_6	60.43	82	29	5130	5.57	1712
T_7	64.33	83	29	5800	6.20	1807
T_8	62.50	79	34	5320	6.86	1444
T_9	68.00	82	26	5130	7.06	1424
T_{10}	64.00	79	12	5000	6.89	1765
Mean	58.58	80	25	4887	6.14	1564
S.E.±	1.46	1.57	0.89	0.39	0.14	44
C.D. (P=0.05)	4.21	4.51	2.55	1.11	0.41	128

morphological, growth, and biochemical parameters. Similar results were also reported in little millet (Charurvedi *et al*., 1990), proso millet (Liu and Zhang, 1989) and foxtail millet (Bhoite, 2000). Begum *et al.* (2013) stated that the greater drought tolerant index and larger yield gap between the foxtail millet genotypes under normal and stress condition. The grain yield of varagu was significantly influenced by the foliar spray of different growth regulators and nutrients. Significantly higher yield was registered (1807 kg) with the treatment of 0.5% $FeSO_4$+ 0.5% urea spray in comparison with the control (1395 kg) (Fig. 2). Balsamo *et al.* (2006) observed an increase in leaf tensile strength in teff during drought, and in little millet, an increase in root length was reported by Ajithkumar and Panneerselvam (2014).

Millet gave better yield under irrigated condition by promoting greater plant growth and more seeds per plant than when irrigation was not applied. Millets might provide alternative climate-smart crops, as their adaptations to challenging environment are better than the current major crops of the world.

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