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Response of micronutrients foliar spray on leaf area, leaf area index, TDMA and yield variation in Varagu under rainfed condition

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Abstract

Minor millets are highly nutritious and even superior to rice and wheat in certain constituents. However, realizing the nutrient composition of these grains and their importance in human diets, they are now considered as nutri – cereals. Water deficit is one of the most common environmental stresses that affects growth and development of plants. The use of chemicals and bioregulators is the quickest and surest way of boosting crop production. In shortage water conditions,0.5% $FeS0_4$+ 0.5% Urea foliar spray to mitigate the water stress and increase the yield also. The present investigation was conducted in the Centre of Excellence in millets, Athiyandal, Tiruvannamalai district during *kharif'* (September, 2015-January, 2017) through foliar spray of micronutrients combination used to increase the Varagu yield under rainfed condition.

Keywords: Growth regulator, No of leaves, Leaf area, Leaf Area Index, and yield

Introduction

Water deficit is one of the most common environmental stresses that affects growth and development of plants (Aslam *et al*., 2006) [2]. Millets can be successfully grown in a wide range of environmental conditions, being better adopted than most crops to hot, dry regions. Millet is a general term for a wide range of small seeded cereals. They are of potential value particularly in semiarid regions because of their short growing season. They can either tolerate drought and intense heat or avoid these conditions by growing to maturity very quickly (Baltensperger, 2002) [4]. Varagu is reported to be resistant to flood, drought, pest and diseases. However, the crop is susceptible to lodging and the seeds have no dormancy period. These crops have traditionally been the indispensable component of dry farming system. Millets possess several morpho-physiological, molecular and biochemical characteristics which confer better tolerance to environmental stresses than major cereals. Primarily, the short lifecycle 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) [8]. Also, the C4 photosynthetic trait is highly advantageous to millets. In the C4 system, carbon dioxide (CO2) is concentrated around ribulose-1,5-bisphosphate carboxylase/oxygenase (RuBisCO), which in turn suppresses ribulose 1,5-bisphosphate (RuBP) oxygenation and photorespiration. 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.

Macro and micronutrients deficiencies have been reported for different soils and crops (Hussain *et al*., 2006) [6]. Mehrvaez and Chaichi (2008) [10]. Micronutrient elements are needed in relatively very small quantities for adequate plant growth and production, their deficiency may cause great disturbance in the physiological and metabolic processes involved in the plant. Thus, the application of micronutrients fertilizer in the cultivation zone may not be meeting the crop requirement for root growth and nutrient use.

Several morpho physiological and biochemical studies in millets have shown their stress adaptation strategies. Balsamo *et al* (2006) [3] 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) [1]. Similarly, increase in biochemical activities such as enhanced levels of antioxidants, reactive oxygen species and their scavenging enzymes, enzyme activity of catalase and superoxide, and synthesis of osmolytes and other stress-related proteins has been reported in response to abiotic stresses in foxtail millet (Lata *et al*., 2011) [7]. Being C_4 plants these are more environment friendly with higher water Use Efficiency and low input requirement, but equally responsive to high input management crops.

Brassinosteroid enhances cell division, cell elongation and also cell differentiation. 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. 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. 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.

Potassium is an important nutrient for improving the crop yield per unit area. Potassium is vital for physiological processes, water availability, photosynthesis, assimilate transport and enzyme activation with a direct effect on crop production. Potassium deficiency significantly reduces the leaves number and size of individual leaf and as a result photosynthetic activity of the plant was affected. (Traditionally, potassium fertilizer directly are applied to soil gets fixed with clay minerals and becomes unavailable to crop plants. Foliar application of potassium is more suitable, target oriented and economical technique for increasing the fertilizer use efficiency and grain yield over soil application.

Materials and Methods

A field experiment was conducted at Centre of Excellence in millets, Athiyandal, Tiruvannamalai district during *kharif*' (June, 2015 to 2018). 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. Number of leaves, Leaf Area and Leaf Area Index 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.

Treatments

T_1-Control
T_2-Water Spray
T_3-1 % KCl Spray
T_4-0.1 ppm BrassinosteroidSpray
T_5-100 ppm Salicylic Acid Spray
T_6-0.1% PPFM Spray
T_7-0.5% $FeS0_4$+ 0.5% Urea Spray
T_8-100 ppm Salicylic Acid+0.5% $FeS0_4$+ 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% $FeS0_4$+ 0.5% Urea Spray

Time of sprays: First spray at Active tillering stage, second spray at Panicle Initiation stage

Table 1: Impact of foliar spray of nutrients with growth regulators on Leaf Area (cm^2 $plant^{-1}$), Leaf Area Index, TDMA (Kg ha^{-1}), No of grains per panicle and Grain yield (kg/ha) on grain filling stage

Treatments	Leaf Area (cm^2 $plant^{-1}$)	Leaf Area Index	TDMA (Kg ha^{-1})	No of grains per panicle	Grain yield (kg/ha)
T_1-Control	405.59	0.90	3420	44.67	1395
T_2-Water Spray	419.30	0.93	4320	51.67	1420
T_3-1 % KCl Spray	482.60	1.07	5130	36.67	1667
T_4-0.1 ppm BrassinosteroidSpray	579.67	1.29	4680	56.00	1556
T_5-100 ppm Salicylic Acid Spray	632.02	1.40	4940	40.67	1454
T_6-0.1% PPFM Spray	522.39	1.16	5130	42.67	1712
T_7-0.5% $FeS0_4$+ 0.5% Urea Spray	683.86	1.52	5800	55.67	1807
T_8-100 ppm Salicylic Acid+0.5% $FeS0_4$+ 0.5% Urea Spray	442.53	0.98	5320	48.67	1444
T_9-1 % KCl+100 ppm Salicylic Acid+0.5% $FeSO_4$+ 0.5% Urea Spray	521.21	1.16	5130	47.00	1424
T_{10}-1 % KCl+0.1 ppm Brassinosteroid+0.5% $FeS0_4$+ 0.5% Urea Spray	653.33	1.45	5000	57.33	1765
S. Ed	474.18	0.90	4887	48.10	1564
C.D. (P=0.05)	47.77 137.42	0.11 0.31	0.39 1.11	2.07 5.95	44 128

Results and Discussion

Water stress reduced seed yield and its component, significantly. Stress at ear emergence stage caused the greatest reduction in seed yield (because of pollination susceptibility to water stress). Yadav *et al*. (1999) [13] indicated that drought after flowering of pear millet decreased seed yield through reduction of number of ear per m2 and seed per ear and seed weight. Further researchers also show seed yield reduction of millet under water stress is as a result of reduction in these yield components (Mahalakshmi & Bidinger, 1985; Prasad *et al*. 1986) [9, 7, 11]. Seed weight decline could be through reduction of seed growth rate as well as seed filling period. Mahalakshmi & Bidinger (1985) [9] reported that drought stress at seed filling stage reduced seed yield up to 50%. The measurement of seed yield components showed that seed yield decline was mainly due to reduction of seed number per ear and seed weight. Seed number reduction could be as a result of stress effect on pollination and floret abortion

(Bradford, 1994) [5]. The Leaf Area, Leaf Area Index (LAI), TDMA and No of grains per panicle of Varagu was significantly influenced by the foliar spray of different growth regulators and nutrients. Significantly higher Leaf Area (683.86), Leaf Area Index (1.52), TDMA (5800) and No of grains per panicle(56)was registered with the treatment of 0.5% FeSO4+ 0.5% urea spray in comparison with the control.

Six millet species (namely kodo, finger, proso, foxtail, little and pearl millets) were shown to have an anti-proliferative property and might have a potential in the prevention of cancer initiation. The anti-proliferative property of these millets is associated with the presence of phenolic extracts. Agricultural drought occurs when there is not enough soil moisture to meet the needs of a particular crop at a particular time. Drought is also commonly expressed as a shortage or absence of rainfall causing a loss in rain-fed agriculture. For example, the decline in the level of rainfall during severe drought was accompanied by serious reductions in rain-fed agricultural outputs; this is because a 10% drop in rainfall (below the long-term national averages) results in an average drop of 4.2% in cereal yields.

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