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RESEARCH PAPER

Effect of *Panchagavya* foliar spray on the plant metabolism and grain yield of Tenai under rainfed condition

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Abstract : The crop growth and development are constantly influenced by environmental conditions such as stresses which are the most important yield reducing factors in the world. Millets cultivation is the most important agricultural operation in the country, not only in terms of food security, but also in creating better livelihoods, opportunities for rural population. Water stress and other abiotic stresses can dramatically limit and reduce the plant growth and productivity. In the frame of physiological window, mild drought induces regulation of water loss and uptake in plants allowing maintenance of their leaf relative water content within the limits where the photosynthetic capacity shows no or little changes. But severe drought induces unfavourable changes in plants, leading to inhibition of photosynthesis and growth. The use of bioregulators is the quickest and surest way of boosting crop production under rainfed condition. *Panchagavya* is an organic product blended from five different cow products, commonly applied to crop plants in organic farming. It is used as foliar spray, soil application and seed treatment. It can act as growth promoter and immunity booster. The organic *Panchagavya* foliar spray significantly influenced various physiological and biochemical parameters. A field experiment was conducted at Centre of Excellence in Millets, Athiyandal, Tiruvannamalai, during *Kharif*, 2017 to study the effect of *Panchagavya* foliar spray for enhancing the productivity of tenai under rainfed situation. In a water shortage conditions, application of enriched FYM +Recommended dose of fertilizer + 3% *Panchagavya* foliar spray improves plant height, no. of tillers per plant, total dry matter partitioning, SPAD chlorophyll content and highest grain yield (1739.0 kg ha^{-1}) of tenai under rainfed condition.

Key Words : Bioregulators, *Panchagavya*, Plant height, No. of productive tillers, SPAD chlorophyll, TDMA, Yield

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INTRODUCTION

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. Millets grown area in India is around 0.7 million ha and the production is 0.42 million tonnes on 2013-14. Millets are also unique due to their short growing season. They can develop from planted seeds to mature, ready to harvest plants in as little as 65-85 days. This is important in heavily populated areas. Millets cultivation is the most important agricultural operation in the country, not only in terms of food security, but also in creating better livelihoods,

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opportunities for rural population. 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. Use of chemical fertilizers and pesticides in agriculture fields led to environmental degradation and hence as an alternative to chemicals. *Panchakavya* is also being sought to improve crop establishment and health (Shakuntala *et al*., 2012). Therefore, *Panchakavya* has played a significant role in providing resistance to pests and diseases, resulting in increased overall yields (Tharmaraj *et al.,* 2011 and Sumangala and Patil, 2009).

Foxtail millet is important minor millet belonging to the family poaceae. The estimated Indian country production of foxtail millet is 0.56 lakh tonnes contributed from an area of 0.98 lakh ha. It is suited to conditions of low and moderate rainfall area due to early maturity period. Foxtail millet ranks second in the total world production of millets and continues to occupy an important place in world agriculture, providing approximately six million tons food to millions of people. Besides India, it is also grown in China, Russia, Japan, USA and other African and East Asian countries. In India, the cultivation of fox millet is confined to Andhra Pradesh, Karnataka, and Tamil Nadu. Foxtail millet coming under the C_4 type photosynthesis. Leaves of C_4 species have higher CO_2 exchange rates, a larger ratio of cross-sectional phloem area to leaf area and greater translocation rates. Leaves of C_4 species also export a larger percentage of their assimilate within a few hours than do C_3 species. Presence of macro (N, P, K and Ca) and micro (Zn, Fe, Cu, Mn) nutrients besides total reducing sugars (glucose) were observed in *Panchagavya*. Chemolithotrops and autotropic nitrifiers (ammonifers and nitrifers) present in *Panchagavya* which colonize in the leaves increase the ammonia uptake and enhance the total N supply. Beaulah (2001) reported that the secondary and micronutrients (Ca, S and Fe), macronutrients (NPK) contents of leaves and pods of annual moringa were superior under poultry manure+ *Neem* cake + *Panchagavya* treatments. Macro and micronutrients deficiencies have been reported for different soils and crops (Hussain *et al*., 2006). Guenis *et al*. (2003) and Soleimani (2006) reported marked increase in number of grains spike-1 of wheat for foliar application of boron and zinc, respectively. Torun *et al*. (2001) and Grewal *et al.* (1997) reported increased wheat production with application of zinc and boron over control. The present investigation was carried out to study the basal application of FYM and *Panchagavya* foliar spray variation in morop-physiological traits and their relationship with productivity and to identify the suitable treatment for higher productivity of tenai under rainfed condition. Kumar *et al*. (2011) concluded that application of 100 per cent jatropha oil cake with 3 per cent foliar spray of *Panchagavya* improves soil microbial population and also increase enzyme activities *viz*., dehydrogenase, urease and catalase in the soil. Sakthivel (2011) found that application of *Pongamia pinnata* as green leaf manure and *Moringa oleifera* as foliar spray influences the soil bacteria, fungi and actinomycetes population in the black gram field. Lucas *et al*. (2014) found that organic amendments can be used to manipulate soil microbial community structure to promote aggregation in soils. Sultani *et al*. (2007) and Wijesinghe *et al*. (2009) found that application of green manure to crops, reduced bulk density, enhanced total porosity. Incorporation of green leaf manure (*Gliricidia sepium*) improved the soil properties of home garden significantly when compared to cropping field, although the impact declined with increasing inclination and the soil depth.

Panchagavya means "mixture of five products (cowdung, cow urine, milk, *Ghee* and curd) of cow. Of these, the three direct constituents are cowdung, urine, milk and the two derived products are curd and *Ghee. Panchagavya* is an organic product derived from five products evolving from cow and it has been used in Indian medicine, since time immemorial of allopathic medical practitioner with deep conviction in ecological farming, sustainable agriculture, traditional knowledge and wisdom of the value *Panchagavya* and utilized to cultivate medicinal herbs. *Panchagavya* is an organic product recommended for crop improvement in organic agriculture (Sangeetha and Thevanathan, 2010). Microbial flora of soil plays an important role in soil health. The micro-organisms present in the rhizospheres environment around the roots influence the plant growth and crop yield. The beneficial micro-organisms from *Panchagavya* and their establishment in the soil improved the sustainability of agriculture.

MATERIAL AND METHODS

A field experiment was conducted at Centre of Excellence in Millets, Athiyandal during *Kharif* season of 2017-18. The experiment was laid out in Randomized Block Design with three replications. Tenai Variety CO

(Te) 7 was sown with a spacing of 30 cm x 10 cm and raised following recommended package of practices. Bio-fertilizer (Azosspirillum (1200 g), Phosphobacteria (1200g)) and Pesudomonas 1200g was applied basally per ha^{-1} during the last ploughing and spread uniformly over the entire experimental area.

Treatments:

T_1 - RDF (40:20:0) NPK ha^{-1}

T_2 - FYM 12.5 t ha^{-1}

T_3 - FYM+RDF

T_4 - Enriched FYM 750 kg ha^{-1}

T_5 - Enriched FYM+RDF

T_6 - Enriched FYM + 3 % *Panchagavya* 1 spray @ 20 DAS

T_7 - Enriched FYM + *Panchagavya* 2 spray@20 and 40 Das

T_8 - Enriched FYM +RDF + *Panchagavya* 1 spray@20 DAS

*RDF - Recommended dose of fertilizer

*FYM- Farm yard manure.

RESULTS AND DISCUSSION

Organic farming gives major emphasis on recovery and maintenance of soil fertility and for sustainable yield. Organic farming helps to improve the physical, chemical and biological properties of soil and maintains the ecological balance as well as productivity of life supporting systems for the future generations. Organic manures in agriculture add much needed organic and mineral matter. Various nutrient management techniques significantly influenced the plant height of foxtail millet at all stages. Angelova *et al.* (2013) observed that soil chemical properties and nutrient availability are substantially improved in soils receiving organic amendments. Compared with the unamended soil, soil treated with organic amendments showed apparent increases of organic matter, total N, EC, available macro elements (P, K, Ca and Mg). Plant height of foxtail millet was found to be significantly higher under enriched FYM + RDF + 3 % *Panchagavya* spray on 20 DAS (T_8) at 20, 40, 60 DAS and harvest stage (21.2, 63.8, 134.8 and 143.0 cm) followed by enriched FYM + RDF (T_5) (25.7, 60.6, 126.7 and 135.6 cm). Application of RDF + *Panchagavya* foliar spray increased the plant height due to increase in protein synthesis and cell growth of millet crops (Vijayalakshmi, 2005). SPAD reading of foxtail millet was found to be higher value of 24.6, 38.8 and 30.5 under enriched FYM + RDF + 3 % *Panchagavya* Spray at 20 DAS (T_8) at 20,40 and 60 DAS, respectively. Application of enriched FYM+RDF + 3% *Panchagavya* spray at 20 DAS (T_8) significantly registered the highest dry matter production of 2705.0 kg ha^{-1}. This is followed by application of enriched FYM + RDF (2465.0 kg ha^{-1}) (T_5) and the least dry matter production were registered under FYM 12.5 t ha^{-1} (T_2) (956.0 kg ha^{-1}). The treatmental effect significantly promoted the total number of productive tillers per plant. Application of enriched FYM+RDF+3% *Panchagavya* spray at 20 DAS resisted the higher number of productive tillers (6.8) (T_8), followed by application of enriched FYM + RDF (5.8) (T_5). Nutrient management techniques significantly influenced grain yield of foxtail millet. The grain yield ranged from 902.0 to 1739.0 kg ha^{-1}. Application of

Table 1: Effect of different nutrient management techniques on plant height (cm), SPAD chlorophyll content, no. of tillers $hill^{-1}$ and total dry matter production (kg/ha) of foxtail millet

Treatments		Plant height (cm)	SPAD chlorophyll content	Number of productive tillers $hill^{-1}$	TDMP (kg/ha)
T_1	RDF(40:20:0)NPK kg ha^{-1}	109.0	24.3	3.1	1920
T_2	FYM 12.5 t ha^{-1}	105.8	24.5	2.8	1540
T_3	FYM+RDF	120.0	34.4	4.0	2984
T_4	Enriched FYM 750 kg ha^{-1}	114.0	31.4	3.3	2260
T_5	Enriched FYM+RDF	135.6	35.1	5.8	4533
T_6	Enriched FYM + 3 % *Panchagavya* 1 spray @ 20 DAS	129.1	29.1	4.3	3600
T_7	Enriched FYM+3 % *Panchagavya* 2 spray@20 and 40 DAS	133.0	31.2	5.4	3820
T_8	Enriched FYM +RDF + 3% *Panchagavya* 1 spray@ 20 DAS	143.0	38.8	6.8	5200
S.E.±		8.9	0.3	0.2	222
C.D. (P=0.05)		19.0	0.7	0.5	474

enriched FYM + RDF + 3% *Panchagavya* spray at 20 DAS (T_8) registered the highest grain yield (1739.0 kg ha^{-1}). This was followed by application of enriched FYM + RDF (T_5) (1526.0 kg ha^{-1}). The lowest grain yield of foxtail millet (902.0 kg ha^{-1}) was recorded in application of FYM 12.5 t ha^{-1} (T_2). Enriched FYM was prepared by adding 10 kg of urea by pit method in12 m^{-3} pit from cattle manure and subjected to microbial fermentation for 90 days before field application (Achieng *et al*., 2010 and Tolessa and Friesen, 2004).

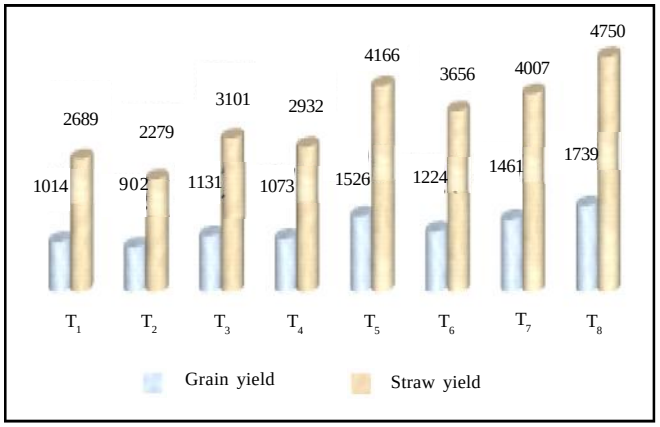

Fig. 1 : Effect of different nutrient management techniques on grain yield (kg/ha) and straw yield(kg/ha) of foxtail millet

The increased uptake of nutrients might be due to increased organic acids with respect to microbial decomposition of organic matter of FYM, the band placement of enriched FYM 2 t ha^{-1} + 100 per cent recommended N and K and broadcasting of enriched FYM at 4 t ha^{-1} + 100 % N and K were found to be the best treatments for rainfed finger millet for improving the soil fertility status, yield and net monetary returns (Jagathjothi *et al*., 2010). Tharmaraj *et al*. (2011) says *Panchagavya*, a Vedic formulation for increased productivity, disease resistance in plants and potential of utilizing *Panchagavya* as biofertilizer was tested on various pulses *Vigna radiate, Vigna mungo, Arachis hypogea, Cyanopsis tetragonoloba, Lablab purpureus, Cicer arietinum* and the cereal *Oryza sativa* var. ponni by growing in soil amended with dried traditional and seaweed based *Panchagavya*. Experimental seedling recorded higher rates of linear growth of both shoots and roots as compared to controls and that too maximum growth was observed in seedling grown in soil amended with seaweed based *Panchagavya* at low concentration (1:100; *Panchagavya*; soil). The *Panchagavya* is diluted to three per cent and sprayed on crops to get the best results. Three litres of *Panchagavya* is diluted with 100 litres of water and sprayed over crops to get rid of pests and diseases and also get higher yields. *Panchagavya* is an organic formulation made from cow goods. The usage of fermented organic formulations with supportive beneficial microorganisms as foliar nourishment has been come into the picture of modern agriculture for giving rise to good quality non residue protected food (Galindo *et al*., 2007). *Panchagavya* has resulted in positive effect on growth and productivity of crops as reported by Somasundaram *et al.* (2007). Vennila and Jayanthi (2008) revealed that application of 100 per cent recommended dose of fertilizer along with *Panchagavya* spray (2%) significantly increased the number of fruits per plant, fruit weight g $fruit^{-1}$ and fruit yield q ha^{-1} of okra.

Conclusion:

The combination of organic source of enriched FYM and recommend dose of fertilizer at basal application and followed by one organic growth promoter like *Panchagavyais* influence of crop growth and also increase the yield component and reduce the disease infection of foxtail millet. Finally concluded the farmers have practices both organic and inorganic component at basal application and foliage application of *Panchagavya* improve yield components and quality of tenai under rainfed condition.

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