Theoretical and Practical Implication and Vision for Next Decade

Of late, the scientist and environmentalist, have come to understand that the modern farming tchnology, though helpful in increasing the production, are largely responsible for polluting the environment. They are also convened that at this rate of adoption of modern technologies the sustainability in farming could not be achieved. All the people who are concerned on the environment are focussing their attention in identifying viable and appropriate alternatives to the modern technologies. It is needless to emphasis that development of natural products and traditional knowledge, along can provide the solution. Indigenous technologies as found out by various researchers, are found to be available in plenty and are on different aspects of not only farming but also on every farm activity. The identificatiion, documentation, test verfification and standardization of indigenous technologies are some to yield viable and appropriate alternatives to the presently followed modern technologies. Secondly, there is a large scope for blending the indigenous technologies with that of modern technologies in an effort to maintain the present level of productivity but at the same time achieving the much needed sustainability in agriculture.

Strageties

- Indigenous knowledge have strong roots in rural culture. All the study reveals that there were number of indigenous technologies available on agriculturd and allied activities which may serve as suitable alternative to modern technologies.
- The indigenous technologies may be analysed for their productivity, stability, sustainability and cost-benefit ratio by a multidisciplinary team including biological and social scientists.
- The indigenous technologies should be test verified for each agro-ecological conditions. These technologies can easily be disseminated by the extention workers since they are already deep rooted in the present culture.
- There should be a national level body for documentation, test verification and developing as modern agricultural technologies suitable to each agro-ecological regions.

References

Balasubramaniam, R. (1992). Techno-cultural profile of dry land farmers. unpup. M.Sc. (Ag.) Thesis, TNAU, Coimbatore

Gnana Deepa, A. (1991). Tchno-cultural profil of rice farmers. unpup. M.Sc.(Agr.) Thesis, TNAU Coimbatore.

Kalaivani, S. (1992). Techno-cultural profile of garden land farmers. unpup. M.Sc.(Ag.) Thesis, TNAU, Coimbatore.

Selvanayagam K. (1986). Techno-cultural profile of dry land farmers. unpup. M.Sc.(Ag.) Thesis, TNAU, Coimbatore.

Somasundaram, S. (1995). Indigenous knowledge in farming systems unpup. Ph.D. Thesis, TNAU, Coimbatore.

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Effect of growth regulators on biochemical attributes, grain yield and quality in pearl millet (*Pennisetum glaucum* L.R. Br.)

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Abstract : The effect of foliar spray of brassinosteroid (BR), triacontanol, salicylic acid (SA), naphthalene acetic acid (NAA) and mepiquat chloride (MC) on pearl millet was studied. These growth regulators, increased chlorophyll, soluble protein, nitrate reductase activity (NRase) indole acetic acid oxidase activity (IAAO) and uptake of nitrogen (N). Grain yield, grain protein and sugar content were also enhanced by these growth regulators. Among the treatments, BR (0.1 ppm) and triacontanol (10 ppm) were found to be more effective. *(Key words: Pearl millet, Brassinosteriod, Triacontanol, Napthalene acetic acid, Salicylic acid, Mepiquat chloride, Soluble protein, Nitrate reductase activity, Indole acid oxidase activity)*

Pearl millet is a staple food crop of the tropical and subtropical regions of the world. It is considered as whole crop utilization - a source of grain for human consumption and fodder for live stock (Gill, 1991). However, the productivity is very low in pearl millet as compared to other cereal crops. (Mander and Sharma, 1995). Brassinosteriod represent a new, sixth group of plant hormone to add to the five "classical" hormones. These steroidal phytohormones have been shown to regulate several physiological responses like cell devision, cell elongation, synthesis of nucleic acids and proteins and enhancement of yield in cereals and vegetables. The uncovering of their involvement in plant growth and development has opened the door for a whole new avenue of plant biotechnology. With this background, a study was initiated to study the effect of foliar application of growth regulators on pearl millet productivity.

Materials and Methods

A study was conducted during 2000 in the Department of Crop Physiology, Tamil Nadu Agricultural University, Coimbatore to study the effect of foliar spray of brassinosteriod (0.1 ppm), triacontanol (10 ppm), salicylic acid (100 ppm) naphthalene acetic acid (40 ppm) and mepiquat chloride (50 ppm) on the biochemical attributes, N uptake and yield in pearl millet. The sprays were given on 30th and 50th days after sowing (DAS). Third leaf from the top was collected of the estimation of different biochemical constituents on 40, 60 and 80 DAS. Estimation of total chlorophyll was carried out by adopting the procedure of Yoshida *et al.* (1971). Soluble protein content was estimated from the TCA extract following the method of Lowry *et al.* (1951). NRase activity was determined using the procedure of Nicholas *et al.* (1976). IAAO was estimated by adopting the method of Parthasarathy *et al.* (1970). Content of nitrogen was estimated by adopting the method of Jackson (1962). Grain yield per hectare was worked out based on the mean plot yield and expressed in kg ha $^{-1}$. Grain protein was estimated by the method of Ali-Khan and Young (1973). Total sugar content was estimated colorimetrically by the method of Somogyi (1952). Statistical analysis was carried out by adopting the procedure of Panse and Sukhatme (1961).

Results and Discussion

Foliar application of growth regulators and chemicals increased the chlorophyll content. Among the treatments, foliar spray of brassinosteriod showed higher chlorophyll content, 3.81 and 1.56 mg g $^{-1}$ on 60 and 80 DAS, respectively followed by triacontanol (Table 1). The soluble protein content was increased by all the treatments at all the stages of observation. BR and triacontanol showed their distinct effect on increasing soluble protein content of 15.14 and 15.05 mg g $^{-1}$ on 60 DAS respectively, while the control plants had 11.16 mg g $^{-1}$ (Table 1). BR stimulates fraction 1-protein synthesis (Braun and Wild, 1984). Richard knowles and Stanley Ries (1981) reported that triacontanol increased the soluble nitrogen pool in rice and corn.

Increase in NRase activity was observed in BR (24.35 mg g $^{-1}$ hr $^{-1}$) followed by triacontanol (23.57) compared to control (17.07) at 60 DAS (Table 1). The positive influence of BR on NRase activity was reported by Sairam (1994) in wheat. Significant increase in RNA and DNA polymerase activity and the synthesis of DNA, RNA and proteins in BR treated mungbean and beans have been reported by Kalinich *et al.* (1985). The stimulated NRase activity was also observed in triacontanol, salicylic acid and NAA treated plants. This might be due to enhancement of nitrogen or nitrate uptake by plant (Muthuchelian *et al.*, 1994). The positive effect of SA on NRase activity was due to its possible role in activation of the inactive nitrate reductase protein and prevention of enzyme degradation by protolysis.

A distinct variation was observed in the case of IAAO by the application of growth regulators (Table 1). All the treatments recorded a more unoxidised auxin content (lower IAAO) compared to control at 40 DAS. The relative efficacy of growth regulators on IAAO indicated that foliar spray of BR as the best, recording high unoxidised auxin content of 189.92 µg g $^{-1}$ hr $^{-1}$ followed by salicylic acid (183.12). Sakurai and Fujioka (1993) reported that BR has negative effect on IAAO. SA also inhibited IAAO and was in accordance with the reports of Jose Siqueira *et al.* (1991) and Kalpana (1997) and the former had suggested that phenolics had the property to suppress IAA destruction.

N content of the whole plant was maximum at 40 DAS . BR, triacontanol and NAA spray could increased the uptake of nitrogen (Table 1). BR spray recorded the maximum values for N content at all the stages by 3.92%, 3.0% and 2.12% at 40, 60 and 80 DAS respectively followed by triacontanol (3.81%, 2.79% and 1.93%). BR application increased the nutrient uptake in wheat (Sairam, 1994). Thus it is possible that BR beside affecting various biochemical activities also enhance water and nutrient uptake. Subbaiah *et al.* (1980) reported that significant increase in nitrogen content in rice by the the application of triacontanol. SA was also found to have direct effect on the nutrient uptake by altering the root physiology, growth rate and root hair production thus affecting soil processes related to nutrient availability (Jose Siqueira *et al.*, 1991).

All the foliar treatments increased the grain yield. BR sprayed plants recorded the maximum yield of 3591 kg ha^{-1} while control recorded the minimum yield of 3018 kg ha^{-1}. The yield increment due to BR spray was 19 per cent (Table 2) followed by triacontanol (16%), NAA (15%) and SA (13%). Significant yield increase by BR application was reported by Sairam (1994) in wheat. Increased grain yield was reported by Subbiah *et al.* (1980) using triacontanol and by Kalpana (1997) using SA in rice. Grains obtained from BR sprayed plants showed higher protein content (9.87%) followed by triacontanol (9.84%) when compared to control (9.45) (Table 2). Positive effect of BR and triacontanol on grain protein were reported by Sairam., 1994 and Subbaiah *et al.*, 1980. Total sugar content was found to be higher in grains obtained from BR sprayed plants (189.34mg g^{-1}) followed by triacontanol (185.62) and SA (179.12) (Table 2). Total sugar in grain was significantly increased by the application for BR in wheat (Sairam, 1994) and triacontanol in rice. (Stanley Ries and Violet Wert., 1977). BR showed a high benefit cost ratio of 2.20 followed by triacontanol (2.09) and SA (2.04).

Table 1. Effect of foliar application of plant growth regulators on biochemical changes and nitrogen content

Treatment	Total chlorophyl (mg g^{-1})			Soluble protein (mg g^{-1})			Nitrate reductase (μg of No_2 g^{-1} hr^{-1})			IAA oxidase activity (μg of unoxidised auxin g^{-1} ha^{-1})			Nitrogen content (%)		
	Days after sowing			Days after sowing			Days after sowing			Days after sowing			Days after sowing		
	40	60	80	40	60	80	40	60	80	40	60	80	40	60	80
Control	1.320	2.700	1.070	6.40	11.16	7.01	13.83	17.07	9.13	159.32	117.92	75.92	3.40	2.50	1.40
Brassinosteroid (0.1 ppm)	2.017	3.810	1.560	8.42	15.14	10.42	17.44	24.35	13.44	189.92	147.71	106.71	3.90	2.80	1.93
Mepiquat chloride (50 ppm)	1.410	2.860	1.200	6.92	11.96	7.42	14.85	18.41	9.83	183.12	141.33	99.65	3.80	2.72	1.87
Naphthalene acetic acid (40 ppm)	1.760	3.527	1.330	8.12	14.92	10.02	15.59	23.41	12.11	181.14	139.18	97.33	3.73	2.71	1.87
Salicylic acid (100 ppm)	1.660	3.430	1.390	8.02	14.59	9.23	17.12	23.26	12.16	162.43	120.41	80.41	3.50	2.55	1.48
Triacontanol (10 ppm)	1.913	3.720	1.480	8.23	15.02	10.21	17.21	23.57	12.68	175.34	133.71	91.32	3.83	2.75	1.89
CD (P=0.05)	0.0222	0.324	0.0187	0.0436	0.0850	0.0387	0.0320	0.670	0.027	0.9171	1.1395	1.8452	0.081	0.073	0.082

Table 2. Effect of foliar application of plant growth regulators on grain yield, protein content and total sugar content

Treatments	Grain yield (kg ha^{-1})	Protein content	Total sugar content mg g^{-1}
Control	3018.55	9.45	163.41
Brassinosteroid (0.1 ppm)	3591.86	9.87	189.34
Salicylic acid (100 ppm)	3427.23	9.76	179.20
Naphthalene acetic acid (40 ppm)	3484.68	9.82	176.32
Mepiquat chloride (50 ppm)	3288,34	9.72	170.12
Triacontanol (10 ppm)	3505.63	9.84	185.62
CD(P=0.05)	5.341	0.032	0.6275

References

Ali-Khan, S.T. and Young, C.G. (1973). Variation in protein content of field peas. *Can. J. Pl. Sci.*, **53:** 37-41.

Braun, P. and Wild, A. (1984). The influence of Brassinosteriod on growth and paramerters of phytosynthesis of wheat and master plants. *J. Plant Physiol.*, **116:** 189-196.

Gill, K.S. (1991). Pearl millet and its improvement. ICAR publications, New Delhi.

Jackson, M.L. (1962). *Soil chemical analysis, Constable and Co. Ltd., London.* pp.498.

Jose Siqueira, O. Muraleedharan, G. nair, Raymond Hammer Schemidt and Gene Safir, R. (1991). Significance of phenolic compounds in plant-soil-microbial systems. *Critical Reviews Plant Sciences,* **10 :** 63-121.

Kalinich, J.F., mandava, N.B. and Todhunter, J.A. (1985). Relationship of nucleic acid metabolism to brassinolide induced responses in leaves. *J. Plant. Physiol.*, **120:** 207-214.

Kalpana, S. (1997). Studies on the effect of botanicals, chemicals and plant growth regulators on growth and productivity in rice (*Oryza sativa* L.) Var. ADT 36. *M.Sc. (Ag).* Thesis, Tamil Nadu Agricultural University, Coimbatore.

Lowry, O.H., Rose Brough, N.T., Farr, L.A. and Randall, R.J. (1951). Protein measurement with folin phenol reagent. *J. Biol Chem.*, **193:** 262-275.

Mander, G.S. and Sharma, T.L. (1995). Production performance of cereal crop in India. *Agric. Situ. India,* **52 :** 57-61.

Muthuchelian, K. Murugan, C., Hari Govindan, R., Nedunchezhian, N. and Kulandaivelu, G. (1994). Effect of triacontanol in flooded (*Erythrina variegata*) seedling 2. changes in $^{14}CO^{-2}$ fixation, ribulose-1, 5-biphosphate carboxylase, photosystem and nitrate reductase activities. *Photosynthetica,* **30 :** 407-413.

Nicholas, J.C., harper, J.E. and Hageman, R.H. (1976). Nitrate reductase activity in soybean. I. Effect of light and temperature. *Plant Physiol.*, **58:** 731-735.

Panse, V.G. AND sukhatme, P.V. (1961). Statistical methods for agricultural workers, ICAR, New Delhi.

Parthasarathy, K., Balu, D.R.C. and Rao, P.S. (1970). Studies on Sandal Spur. *Proc. Indian Acade. Sci.,* **72:** 277-284.

Richard Knowles, N. and Stanley Ries, K. (1981). Rapid growth and apparent total nitrogen increase in rice and corn plants following application of Triacontanol. *Plant Physiol.*, **68:** 1279-1284.

Sairam, R.K. (1994). Effect of homo brassinolide application on plant metabolism and grain yield under irrigated and moisture stress conditions of two wheat varieties. *J. Plant Growth Regulation,* **14:** 1736-181.

Sakurai, A. and Fujioka, S. (1993). The current status of physiology and biochemistry of brassinoteroids. *Plant Growth Regulation.* **13:** 147-159.

Somogyi, M. (1952). Note on sugar determination. *J.Biol. Chem.*, **2:** 145-154.

Stanley Ries and Violet Wert. (1977). Growth response of rice seedling to triacontanol in light and dark. *Planta,* **135:** 77-82.

Subbiah, S., Honora Francis, J. and Ramanathan, K.M. (1980). A note on the effect of triacontanol on the protein content, nutrient uptake and yield of rice. *Madras Agri. J.*, **67 :** 265-267.

Yoshida, S., Forno, D.A. and Cock, J.H. (1971). Laboratory manual for physiological studies of rice, IRRI, Philippines. pp. 36-37.

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