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RESPONSE OF WHEAT (*TRITICUM AESTIVUM* L.) TO THE FOLIAR APPLIED BRASSINOSTEROID AND THIOUREA WITH RECOMMENDED FERTILIZATION PRACTICE ON FARMER'S FIELDS

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Abstract

An on-farm testing was conducted on farmer's fields of Sawai Madhopur district (Rajasthan), India; to assess the performance of bio-regulators and recommended fertilization management in enhancing the productivity of wheat (*Triticum aestivum* L.) under irrigated farming situation. Study of three years pooled data revealed that recommended method and doses of NP (120-40 kg ha^{-1}) along with soil application of $ZnSO_4$@ 20 kg ha^{-1} enhanced the wheat grain yield by 10.29 per cent over farmer's practice (only N P fertilization) and provide additional returns of Rs. 6440 ha^{-1} with incremental B:C ratio of 6.52. While foliar spray of brassinosteroid 0.5 ppm at tillering stage and thiourea 1000 ppm at heading stage along with recommended fertilization practice enhanced the grain yield to the magnitude of 22.08 per cent over farmer's practice (42.64 q ha^{-1}) and fetched average net returns of Rs. 84440 ha^{-1} with additional returns of Rs.13748 ha^{-1} and incremental B:C ratio of 3.33.

Key words : Brassinosteroid, B:C ratio, farmer's fields, thiourea, wheat, zinc.

Introduction

Despite significant achievements through green revolution, there is need of further enhancement in wheat production to feed ever burgeoning population and strengthening food security. Wheat is one of the major crops in Sawaimadhopur district with an area of around 75 thousand hectare with productivity varying in between 35 to 38 q ha^{-1} during 2011-12 to 2013-14. There exist ample scope to improve the wheat productivity in the district at least up to feasible potential of 55-60 q ha^{-1} by systematic adoption of improved agronomic techniques. Improper fertilization, inadequate irrigation facilities and high temperature stress during maturity phase are the major reasons for low productivity. Farmers generally apply only N & P containing fertilizer DAP at sowing time and urea only as top dressing. Continuous cropping with only N and NP containing fertilizers and neglected multi-nutrient deficiencies leading to imbalance among nutrients in soil and poor utilization of applied nutrients as well as other applied inputs. Among the micronutrients, zinc deficiency is the most wide spread and crop responses to zinc fertilization are encouraging.

In recent years, use of bio-regulators has offered new avenues for enhancing productivity of several crops. Partitioning of dry matter to yield storage organs is considered to be a major determinant for agricultural yield and this is dependent on the efficiency of photosynthate translocation in crop during grain filling period when developing grains are the storing sink. It has been reported that bio-regulators plays important role in greater partitioning of photosynthates towards reproductive sink thereby improves the harvest index. Foliar applications of brassinosteroid (Sairam, 1994a & b; Sharma and Sharma, 2008) and thiourea (Sahu and Singh, 1995) have been reported to be effective for enhancing wheat productivity under different environmental conditions.

Among the bio-regulators, brassinosteroids are a group of naturally occurring growth promoting phytohormones, which regulate several physiological processes like cell division, cell elongation, synthesis of nucleic acid and proteins (Mandava, 1988). In wheat, brassinosteroid application showed positive effect on nitrate reductase and glutamine synthetase activities, photosynthesis, chlorophyll content and total soluble protein under both irrigated and moisture stress conditions (Sairam, 1994a & b). Brassinosteroid also increases the resistance of plants against various abiotic stresses *e.g.* low temperature, high temperature, drought stress, salt stress (Rao *et al*., 2002). Thiourea, a sulphydryl

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compound, contains one -SH group beside containing nitrogen in the form of $-NH_2$. It plays several bio-regulatory roles in crop plants, as the –SH group has diverse biological activities (Jocelyn, 1972). Thiourea has been reported to have role in improving photosynthetic efficiency and translocation of photosynthates (Sahu *et al*., 1993). Sahu and Singh (1995) reported that thiourea had a significant role in improving dry matter partitioning towards sink in wheat and enhanced metabolic transport of sucrose to the grain via effect on phloem loading. As the brassinosteroid enhances growth parameters and thiourea plays significant role in dry matter partitioning towards sink, foliar spray of brassinosteroid at tillering stage and thiourea at heading stage might be useful in improving overall productivity of wheat. Keeping in view the these facts, present on-farm testing was conducted on farmer's fields of Sawaimadhopur district to assess the performance of brassinosteroid and thiourea foliar sprays along with recommended fertilization in enhancing productivity of wheat (*Triticum aestivum* L.).

Materials and Methods

An on-farm testing was conducted during three consecutive *rabi* seasons of 2011-12 to 2012-13 on selected farmer's fields of Soorwal, Bhagwatgarh, Gambhira, Karmoda, Sherpur, Badagaon Sarwar, Dhanoli, Kushtala, Karmoda, Badolas, Badagaon Kahar and Gambhira villages of Sawaimadhopur district. The district falls under agro-climatic zone III-B "Flood prone Eastern plains" and zone V "Humid South-eastern plains" of Rajasthan. Climate is mild and moderate in the district with annual average rainfall of 623 mm. The soils of the district is sandy loam to sandy clay, which are generally low in nitrogen and low to medium in available phosphorus. Among micro-nutrients, most of the soils in the district have been found to be deficient in zinc.

In present on-farm testing, technology assessed comprised of recommended doses & time of application of N P (120:40 kg ha^{-1}) along with soil application of zinc sulphate @ 25 kg ha^{-1} and foliar application of brassinosteroid (0.5 ppm) at tillering stage followed by thiourea (1000 ppm) at heading stages of wheat. These treatments were compared with farmer's local practice of basal use of only DAP 80 kg ha^{-1} and top dressing of urea 150 kg ha^{-1} and without foliar spray of bio-regulators.

The details of treatments is as below-

$\mathbf{T_1}$ = Farmers practice (Basal use of only DAP 80 kg ha^{-1} and top dressing of urea 150 kg ha^{-1})

$\mathbf{T_2}$ = Recommended NP (120-40 kg ha^{-1}) at basal and top dressing + soil application of $ZnSO_4$ @ 20 kg ha^{-1}.

$\mathbf{T_3}$ = $\mathbf{T_2}$ + Foliar spray of brassinosteroid 0.5 ppm at tillering and thiourea 1000 ppm at heading stage.

In the recommended fertilization treatment, the half dose of N and full dose of P were drilled at sowing time through Urea and DAP and rest half dose of N were top dressed in two equal splits at first and second irrigations. A uniform dose of 25 kg ha^{-1} of $ZnSO_4.7H_2O$ was applied as basal by spreading at time of last ploughing before sowing. Foliar sprays of brassinosteroid @ 0.5 ppm solution at maximum tillering (45-50 DAS) and lab reagent grade thiourea @ 1000 ppm solution at heading stage (65-70 DAS) were applied with spray volume of 600 litres ha^{-1} and teepol or sticking agent was mixed with solution for better retention.

Wheat variety Raj-3765 during 2011-12 & 2012-13 and Raj-4037 during 2013-14 were used under irrigated timely sown farming situation. Each treatment was replicated on five farmers field's in an area of 0.25 ha. Crop was timely sown during first week to third week of November drilled in 23 cm. rows apart. Farmers applied 4 to 5 irrigations at critical growth stages of the crop. The crop was harvested between second and third week of March. Data related to yield and cost particulars were collected separately for the treatments and farmers practice. The average prices of inputs and outputs commodities prevailed during each year were taken for calculating cost of cultivation, net return and benefit cost ratio.

Results and Discussion

Results of present on-farm testing clearly revealed that recommended fertilization practice and foliar sprays of brassinosteroid and thiourea enhanced wheat grain yields on farmers fields during all three seasons. Data presented in table 1 shows that recommended NP fertilization at basal and top dressing and soil application of $ZnSO_4$ @ 20 kg ha^{-1} enhanced the wheat grain yield by 10.29 per cent over farmer's local practice (42.64 q ha^{-1}). Adequate nutrient supply under recommended fertilization might have facilitated adequate supply of photosynthetic assimilates for better growth and developments of reproductive sink, which could be ascribed for improvements in yield. A perusal of pooled data further shows that foliar sprays of brassinosteroid 0.5 ppm at tillering and thiourea 1000 ppm at heading stage along with recommended fertilization practice enhanced grain yield to the magnitude of 22.08 per cent over farmer's practice (39.24 q ha^{-1}). Plants under the influence of brassinosteroid and thiourea might have maintained greater photosynthetic efficiency, which

Table 1 : Effect of recommended fertilization and foliar application of bio-regulators on productivity of wheat.

Treatments	Mean grain yield (q ha^{-1})			Pooled grain yield (q ha^{-1})	% Increase over FP
	2011-12	2012-13	2013-14		
T_1	44.56	41.20	42.16	42.64	—
T_2	47.96	45.76	47.36	47.03	10.29
T_3	52.64	51.36	52.16	52.05	22.08

Table 2 : Economic evaluation of recommended fertilization and foliar application of bio-regulators in wheat.

S. No.	Gross cost of cultivation (Rs ha^{-1})	Net returns (Rs ha^{-1})	B:C ratio (Gross cost/Gross return)	Additional cost of treatment over FP (Rs ha^{-1})	Additional returns (Rs ha^{-1})	Incre-mental B:C ratio
T_1	27268	70692	2.59	-	-	-
T_2	28255	77132	2.73	987	6440	6.52
T_3	31398	84440	2.69	4130	13748	3.33

provided adequate metabolites to reproductive sinks for greater growth and development. Among these bio-regulators, brassinosteroid sprayed at tillering stage, might have promoted growth parameters on account of its regulatory role played in cell elongation and cell division. Several workers have reported that brassinosteroid had positive impact on cell elongation and division and thereby affects elongation, swelling, curvature and splitting of internode (Mandava and Thompson, 1983). Further, the application of thiourea at heading stage might have improved the yield attributes and yield as it has been reported that thiourea has positive role in enhancing canopy photosynthesis and metabolic transport of photosynthetic assimilates to grains via effect on phloem loading (Sahu and Singh, 1995).

Data on economic evaluation of treatments in terms of net returns, additional returns and B:C ratio are presented in table 2. Data clearly indicates that recommended fertilization and application of brassinosteroid and thiourea proved to be economically feasible and profitable techniques on farmer's fields. On pooled basis, recommended fertilization practice fetched net returns of Rs. 77132 ha^{-1} and provided additional returns of Rs. 6440 ha^{-1} with incremental B:C ratio of 6.52 compared to farmers local practice, which provided average net returns of only Rs. 70692 ha^{-1}. Foliar sprays of brassinosteroid and thiourea with recommended fertilization further raised the average net returns to Rs. 84440 ha^{-1} and on pooled basis, provided additional returns of Rs. 13748 with incremental B:C ratio of 3.33 over farmer's local practice. It clearly shows that by the additional expenditure of Rs. 4130 ha^{-1} on foliar application of bio-regulators and recommended fertilization, a farmer could be able to earn Rs. 13748 ha^{-1}. Despite the general conception that brassinosteroid and thiourea are expensive high-tech agro-chemicals, the average B:C ratios observed in present study were found higher as 2.73 and 2.69 for T_2 and T_3; respectively as against 2.59 under farmer's local practice, which justified the feasibility of these bio-regulators. Farmer's were also found greatly convinced with the results of foliar applied bio-regulators along with recommended fertilization practice.

Conclusion

In the light of the results emanated from the present on-farm testing it can be concluded that under micro-farming situations of Sawai Madhopur district, foliar applications of brassinosteroid 0.5 ppm solution at tillering stage followed by thiourea 1000 ppm solution at heading stage and soil application of zinc sulphate @ 20 kg ha^{-1} along with recommended NP fertilization (120-40 kg ha^{-1}) proved to be feasible technique for enhancing wheat productivity on farmers fields. Above findings may be further tested at different locations for inclusion in package of practices.

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