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SHORT COMMUNICATION

EFFECT OF BIOREGULATORS AND MOISTURE STRESS ON DRY MATTER ACCUMULATION AND ITS PARTITIONING IN MUSTARD

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A field study was conducted during the two consecutive Rabi seasons 2001-02 & 2002-03 to study the role of bioregulators and moisture stress on partitioning of biomass in *Brassica juncea.* Results revealed that three irrigations (no stress) at BI + 50% flowering + 50% pod development accumulated significantly higher total dry matter per plant over no irrigation (crop under stressed) at physiological maturity. In terms of dry matter partitioning, significantly higher dry matter was allocated to pods under three irrigations. Brassinosteroid (foliar) caused accumulation of maximum total dry matter as compared to rest of the treatments at physiological maturity. Thiourea application (S+F) affected the allocation of dry matter to various organs by translocating of biomass from stem to pods significantly as the pod weight was highest and 62.5 % more compared to control at physiological maturity.

***Key words: Brassica juncea*, brassinosteroid, drymatter partitioning, thiourea, water stress**

Among oil seeds, rapeseed and mustard is the second largest group grown in India. During 2002-03 it covered an area of 5.1 million ha and produced 5.8 million tones at an average productivity of 1152 kg ha^{-1} (Anonymous, 2003-04). In the state of Rajasthan rapeseed and mustard ranks first among the oilseeds sharing 44% in total oilseed production. Crop production in the rainfed areas is often very difficult and risky because of the environmental stresses. Among the stresses, moisture stress is one of the limiting factor for obtaining optimum yield. Moisture stress during crop growth affects adversely most of the plant metabolic processes and the plant tissues and organs which are in state of rapid growth and development are more sensitive to water deficit. To revert the inhibitory effect of water stress, growth regulator application can help in modifying physiological processes in plants. Synthesis, translocation, partitioning and accumulation of photosynthates within the plant are controlled genetically and influenced by the environment (Snyder and Carlson 1984). Present study was undertaken to evaluate the accumulation and partitioning pattern of biomass in mustard under moisture stress and bio-regulator application.

Field experiments were conducted during 2001-02 and 2002-03 rabi seasons to study the role of bioregulators in mitigating moisture stress in mustard at Rajasthan College of Agriculture, Udaipur (Rajasthan) situated at 24^{0}35' N latitude and 74^{0}42' E longitude with an altitude of 579.50 meter above mean sea level.The treatments consisted of irrigation levels (no post sowing irrigation, one irrigation at branch initiation (BI), two irrigations at BI + 50% pod development and three irrigation at BI + 50% flowering + 50% pod development and seven levels of bio-regulators [control, brassinosteroid at 0.4 ppm with seed treatment (s), brassinosteroid at 0.4 ppm with foliar application (F), brassinosteroid at 0.4 ppm with seed + foliar application (S+F), thiourea at 1000 ppm

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with seed treatment (s), thiourea at 1000 ppm with foliar application (F) and thiourea at 1000 ppm with both seed + foliar application (S+F)]. Combinations of these treatments were evaluated under split plot design, allocating irrigation levels in main plot and bioregulator treatments in sub plot with tree replications.

The soil of experimental field was clay loam in texture, slightly alkaline in reaction (pH-8.1) and medium in available nitrogen and phosphorus. Foliar spray of thiourea (1000 ppm) and brassinosteroid (0.4 ppm) was applied at anthesis and 15 days after first spray as per treatment during both the years using spray volume of 600 1. $Ha^{-1.}$ The irrigations were applied to crop as per treatment i.e. at branch initiation (30, DAS), 50% flowering (45-50, DAS) and 50% pod development (85-90 DAS), in both the years. The measured quantity of irrigation water was applied to each treatment using parshl flume.

Maximum total dry matter $plant^{-1}$ (Table 1) was recorded by the application of three irrigations (B1+50% flowering + 50% pod development) which was significantly superior over rest of the treatments at physiological maturity. The mean stem, leaf and pod dry matter also recorded significantly superior over no irrigation. The analysis of plant water relation parameters indicate that reduction in crop growth in stressed crop plant (no irrigation) was a consequence of water shortage and its adverse effect on metabolism of crop plants. Moisture stress decreased carbohydrate translocation interrupted nitrogen metabolism, forced loss of turgor and caused reduction in sink size and growth (Versan and Philips, 1978). Garg et al. (2001) reported that decreasing irrigation levels progressively decreases leaf area and plant height of mustard.The correlation studies substantiated positive association between total dry matter DMA at physiological maturity and plant height at harvest (r=0.952) and biochemical components i.e. chlorophyll content at 80 DAS (r= -0.638), proline content at 80 DAS (r= -0.851). Further, the regression analysis also revealed that a unit increase in plant height the DMA per plant increased by 0.326 g $plant^{-1}$.

Foliar application of brassinosteroid (0.4 ppm) recorded highest total dry matter per plant at physiological maturity (Table1). On mean basis, as compared to control 35.1 per cent higher dry matter per plant was recorded. Further data reveals that among bioregulators, thiourea applied both as seed treatment and foliar spray recorded maximum pod dry matter and least dry matter of stem compared to physiological maturity. The increase in pod dry matter was to the magnitude of 65.6 % compared to control. Several workers reported significant improvement in crop growth under the influence of brassinosteroid due to its positive impact on cell elongation, swelling, curvature and splitting of the second internode (Mandava 1988). These findings suggest the involvement of brassinosteroid in transcription and replication during tissue growth. Under the influence of brassinosteroid, changes in enzyme activities apparently affect nucleic acid metabolism such that the levels of accumulated RNA, DNA and proteins in the tissue increased during growth (Kalinich *et al*. 1985). The increase in dry matter by brassinosteroid might be because of increase in leaf chlorophyll and soluble proteins (Rani *et al.* 1989), increase of activity of nitrate reductase in roots and leaves and chlorophyll content and photosynthesis in irrigated and stressed condition (Sairam 1994).

It is noteworthy that thiourea containing -SH group is a non-biological thiol and stimulate dark fixation of CO_2 in embryonic axis of chickpea. Because of the -SH group, thiourea may play several bioregulatory roles in crop plants and has diverse biological activity. Involvement of -SH group in phloem transport of sucrose has been suggested (Giaquinta 1977). This is evidenced by increasing DMD in pods. Giaquinta (1977) stated that for plant to grow, sugar and other assimilates must be consistently transported from the leaves to growing or storage region. This essential transport function takes place in the highly specialized phloem tissue which consists of a net work of interconnecting sieve tubes. Inspite of its obvious agronomic importance, little is known about first step of sugar entry (loading) into the sieve tubes. Since the -SH group is essential at the substrate binding site of the amino acid carrier (Mc Cormic and Johnstone 1990). Foliar spray of thiourea in the present study might have enhanced formation of the ternary complex, surcrose $–H^+$ carrier, this improving phloem loading of sucrose and hence translocation of

Table 1. Effect of irrigation levels and bioregulators on dry matter accumulation (g plant^{-1}) at physiological maturity

Treatments	Stem 2001-02	Stem 2002-03	Stem Mean	Leaf 2001-02	Leaf 2002-03	Leaf Mean	Pod 2001-02	Pod 2002-03	Pod Mean	Total 2001-02	Total 2002-03	Total Mean
Irrigation levels												
No irrigation	8.52	10.41	9.47	6.18	6.82	6.50	6.13	6.64	6.39	20.82	23.88	22.35
One irrigation	14.68	15.38	15.03	8.21	7.70	7.96	6.87	7.40	7.14	29.76	31.48	30.62
Two irrigation	16.56	17.33	16.95	9.41	9.79	9.6	8.19	8.67	8.43	34.15	35.80	34.98
Three irrigation	17.88	18.86	18.37	10.47	10.73	10.6	9.28	9.73	9.51	37.64	39.32	38.48
SEm±	0.273	0.293	-	0.206	0.227	-	0.179	0.188	-	0.616	0.682	-
CD (P=0.05)	0.944	1.013	-	0.712	0.785	-	0.621	0.649	-	2.132	2.360	-
Bioregulators												
Control	13.31	14.60	13.96	6.36	6.48	6.42	5.52	5.84	5.68	25.19	26.94	26.07
Brassinosteroid (seed)	14.93	15.44	15.19	8.43	8.62	8.53	7.31	7.45	7.38	30.66	31.53	31.10
Brassinosteroid (foliar)	16.58	17.21	16.90	9.65	9.92	9.79	8.23	8.83	8.53	34.48	35.96	35.22
Brassinosteroid (S + F)	16.18	17.06	16.62	9.84	9.91	9.88	8.07	8.62	8.35	34.08	35.59	34.84
Thiourea (seed)	14.21	15.28	14.75	8.32	9.24	8.78	7.06	7.41	7.24	29.58	31.93	30.76
Thiourea (foliar)	12.81	14.34	13.58	8.63	9.37	9.00	8.35	8.95	8.65	29.79	32.66	31.23
Thiourea (S + F)	12.85	14.53	13.69	8.74	9.53	9.14	8.78	9.67	9.23	30.38	33.73	32.06
SEm±	0.312	0.353	-	0.217	0.229	-	0.194	0.227	-	0.630	0.648	-
CD (P=0.05)	0.886	1.004	-	0.618	0.650	-	0.551	0.646	-	1.791	1.843	-

photosynthates. It was noted that not only accumulation of dry matter increased due to effect of thiourea treatments, but translocation of dry matter was also found to be higher under thiourea treatment.

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