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Drought stress response on some morphological traits and seed yield of Indigo (*Indigofera lignifora* L.) under Tropical conditions

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Abstract

Irrigation plays a major role in the growth and production of indigo plant. Drought tolerant and resistant plants are mostly selected for culture in irrigated and semi-irrigated fields for better production. Indigo plant is a resistant plant to drought for warm climate. This study was carried out to assess the drought stress and nitrogen on yield and some physiological features of the Indigo plant in Bihar in 2018. The study consists of randomized complete block design with three replications and irrigation was done after depletion of 90% and 50% of field capacity. Results revealed that no stress + 130 kg nitrogen ha^{-1} increased plant height, No. of Shoot/plant and No. Pod/plants of indigo as 72.80 cm, 8.90 cm and 383 cm, respectively. Water deficit stress had different effects on plants. Results showed that drought stress + 50 kg nitrogen ha^{-1} and no stress + 130 kg nitrogen ha^{-1} increased the No. of seed/pod of the plant at 5.30 kg/h. The most grain yield of about 226 kg ha^{-1} was obtained from the highest density in the optimum irrigation treatment.

Keywords : Indigo, Drought stress, Nitrogen and Yield seed, Irrigation, Bihar

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Introduction

The Indigo (*Indigofera tinctoria* L.) plant belongs to the Fabaceae family and is mostly cultivated in tropical regions of the world for industrial uses. The plant is perennial, but it is cultivated as an annual plant.

The roots and stems of indigo taste bitter. They are acting as expectorants and are useful in healing stomach and bowel worms. They also pacify hair fall. All parts of the plant mitigate inflammation and useful in healing chronic bronchitis, asthma, hemorrhoid, insects bites, injury healing and skin disorders. The main objective in agriculture production focused mostly on the increasing of yield and production. Since India is located on a mixed climate and has different climates, the recognition of traits related to growth and yield, especially in relation to drought stress can remarkably affect the development of planting area and its yield increase. Ahmad *et al.* (2009) reported that plant height and plant dry matter decreased with increasing water stress under controlled conditions. Karam *et al.* (2007) showed that with increasing drought stress leaf area index, grain yield and its component decreased. Relative water content of the leaves decreased under drought stress. Ali Meo (2000) conducted that plant height and number of grains head-1 decreased significantly by lowering the nitrogen level or increasing drought stress. Kalamian et al. (2006) showed that drought stress decreased biologic yield. Furthermore, Anderia *et al.* (2002) showed a decrease in head diameter with increasing drought stress. Singh *et al.* (1996) showed that increase in use of nitrogen

Table – 1. Soil features of Indigo planted fields at two different soil depths

Soil depth (cm)	pH	EC (dsm^{-1})	Total P_2O_5 (ppm)	Total N (%)	Total K_2O (ppm)	Organic Carbon (%)	Soil type
0-30	7.8	1.59	8.3	3	170	0.36	Mixed soil
30-60	8.4	1.48	7.4	2	162	0.27	Mixed soil

caused an increase in grain yield. Therefore the aim of this study was to evaluate the effect of different levels of nitrogen application in different moisture conditions on yield and yield components of Indigo in order to achieve the optimum use of resources.

Materials and Methods

This experiment was conducted in order to investigate the effects of water deficit stress, different levels of nitrogen and drought stress on grain yield and yield components and harvest index in indigo. It was performed during 2018 in the research fields of the Chapra district in Bihar. The experiment was implemented using randomized complete block design with three replications. The main factor was irrigation treatments including optimum irrigation and severe stress. Irrigation was done after a reduction of 90 and 50 percent of field capacity, respectively. Nitrogen was applied at 50, 100, 150 and 200 kg N ha^{-1} nitrogen during the study. Each sub-plot consisted of 7 plant line. Each plant line was 4 meter long. The distance between two sub-plots and two main plots were 1m and 1.5m, respectively. Thus the main plot area was 51.6 m^2 with total area of 2500 m^2 area. The operations of plough and preparation of farm included a deep plough, two vertical disks, leveling, furrow, mound and plot making. The soil texture was loamy silt. The amount of fertilizer added to the farm was determined by soil analysis. The planting was done manually after irrigation. The first irrigation was done on 5 June 2018. The thinning was conducted in 4 - 5 leaf stage. The weeding was conducted in two stages of 20 and 40 days after planting. Nitrogen fertilizer was applied in the form of surplus in two stages of 7 - 8 leafage and flowering time.

The final harvest was performed when the downside of heads turned to brownish yellow. In this stage seeds had 20% of moisture. In order to remove the edge effect, the sampling was not conducted from lateral rows. For determining soil moisture, samples were taken from two depths of soil at 0-30 and 30-60 cm in each (Table - 1).

Analysis of variance was performed using standard techniques and the differences between the means were compared using 't' test [$P < 0.05$] with a Minitab software package.

Results and Discussion

Results showed that no stress + 150 kg nitrogen ha^{-1} increased plant height, No. of Shoot/plant, No. Pod/plants and seed yield of indigo as 72.80 cm, 8.90, 383 and 226 kg/h (Table - 2).

This situation probably was the result of a disorder in the nitrogen absorption process by plant under severe drought stress. The soil texture caused a limitation in the plant ability to absorb nitrate from soil. More nitrogen consumption resulted in increasing plant height and its preservation until the end of the growth period. The results of this study on the effect of applying different amounts of nitrogen on plant height and leaf area agree well with Allison and Haslam (1993). This is because of ability of the plant to access

Table - 2. Some morphological features and seed yield of *Indigo tinctoria* L

Drought Stress (f_c)	Nitrogen (kg/h)	Plant height (cm)	No. of shoot/plant	No. of seed/pod	No. of pods/plants	Seed yield (kg/h)
No stress	40	61.02	7.20	5.10	182	198
	80	71.65	7.50	5.15	198	205
	130	72.80	8.90	5.30	383	226
	180	69.10	7.60	5.15	285	219
50 f_c Stress	80	51.10	7.25	7.25	112	174
	130	53	7.75	6.62	216	187
	180	54	8.25	6.70	154	181

to more nitrogen and increasing reproductive and productive parts. Fathi *et al.* (1997) reported that with increasing nitrogen consumption plant height increased due to more access to absorbing nutrients. This is, in turn, a function of the durability of No. of Shoot/plant after growth stage as well as the sink-source relationship. The seed yield declining at severe drought stress can be related to the lack of stored carbohydrates before pollination stage at productive parts and to decreasing durability of growth at plants of under treatment that resulted in a short period of grain filling. Westgate (1994) reported that the main reason of the grain weight reduction is the decrease in grain filling period due to stress. Drought increment caused a decrease in grain yield under study period. The increasing nitrogen content also caused yield increment during this study. Excess fertilizers at optimum irrigation condition caused considerable increase in grain yield, whereas at no stress drought condition using more quantities of nitrogen did not increased the grain yield. It seems that this situation results from absorption, reduction and increasing nitrogen waste due to water deficit in soil. The most grain yield of about 226 kg ha^{-1} obtained from the highest density at optimum irrigation treatment. Liang *et al.* (1992) reported that maximum grain yield in maize need high irrigation, use of plenty of fertilizer and meeting temperature requirements. Results showed that drought stress + 50 kg nitrogen ha-1 and no stress + 150 kg nitrogen ha-1 increased the No. of Seed/pod of Indigo as 3.47 kg/h (Table - 2). The results showed that with increasing intensity of drought stress there was a significant decrease in biological yield. These results conform the result of Jasso *et al.* (2002) where they also showed decreasing biological yield under drought stress. In this study, increasing the use of nitrogen increased the No. of seed/pod (Table -1). Results showed that drought stress at + 50 kg nitrogen ha^{-1} increased the leaf dry weight of Indigo as 5.12 (Table -1). The reason for increase in total dry matter production in plants under optimum irrigation was the extension of leaf area and its higher durability that provided enough physiological resource to receive more light and producing more dry matter.

Conclusions

Application of water deficit stress results in significant reduction of Plant height, No. of shoot/plant, No. pod/plants, seed yield, shoot dry weight, total dry weight and total fresh weight. By increasing the nitrogen fertilizer from 50 to 150 kg nitrogen ha-1 all the above mentioned traits also increased significantly.

References

Ahmad, S.H., Ahmad, R., Ashraf, M.Y., Ashraf, M. and Waraich, E.A. 2009. Sunflower (*Helianthus* *annuus* L.) response to drought stress at germination and seedling growth stages. *Pak. J. Bot.*, 41(2) : 647 - 654.

Ali Meo, A. 2000. Impact of variable drought stress and nitrogen levels on plant height, root length and grain numbers per plant in a sunflower (*Helianthus annuus* L.) Var. Shams. *Pah. J. Agri. Sci.*, 37(1-2): 89-92.

Allison, J.C.S. and Haslam, R.J. 1993. Theoretical assessment of potential for increasing productivity of sugarcane through increased nitrogen fertilization. *Proc. South African Sugar Technol. Assoc.*, pp: 57-59.

Andria, R., Chiaranda, F.Q., Magliulo, V. and Mori, M. 1995. Yield and soil water uptake of sunflower sown in spring and summer. Agroclimatology., 87(6): 1122-1128.

Fathi, G., McDonald, G.K. and Lance, R.C.M. 1997. Effects of post-anthesis water stress on the yield and grain protein concentration of barley grown at two levels of nitrogen. *Australian journal of Agricultural Research.*, 48 : 67 - 80.

Jasso De Rodriguez, D., Phillips, B.S., Rodrigues-Garcia, R. and Angulo Sanchez, J.L. 2002. Grain Yield and fatty acid composition of sunflower seed for cultivars developed under dry land conditions. *Agron.*, 25: 132-142.

Kalamian, S., SAM Modares sanavi and Sepehri, A 2006. Effect on of water deficit at vegetative and reproductive growth stages in leafy and commercial hybrids of maize. *Agri. Res. Winter.*, 5(3): 38 - 53.

Karam, F., Masaad, R., Sfeir, T., Mounzer, O. and Rouphael, Y. 2007. Evaptranspiration and seed yield of field grown soybean under deficit irrigation conditions. *Agr. Water Manag.*, 75: 226 – 244.

Liang, B.C., Millard, M.R. and Mackenzie, A.F. 1992. Effects of hybrid, population densities, fertilization and irrigation on grain corn (Zea mays) in Quebec. *Can. J. Plant Sci.*, 72: 1163 - 1170.

Singh, G.R., Choudhary, K.K., Chaure, N.K. and Pandya, K.S. 1996. Effect of seed bacterization and nitrogen level on soil properties, yield parameters, yield and economic of sunflower (*Helianthus annuus*). *Indian Journal of Agricultural Science.*, 66: 250 - 252.

Westgate, M.E. 1994. Water status and development of the maize endosperm and embryo during drought. *Crop. Sci.*, 34: 76 – 83.

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