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Effect of drought management practices on growth and yield of Niger (*Guizotia abyssinica* Cass.)

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Abstract
A field experiment was conducted during *kharif* 2019-20 at Experimental farm Dept of Agromomy, College of Agriculture, VNMKV Parbhani to study the effect of drought management practices on growth and yield of niger (*Guizotia abyssinica* Cass). The experiment was laid out in randomized block design (RBD) with 10 treatments with three replications. Among the drought management practices application of KNO_3 @ 2% recorded significantly higher growth parameters *viz* (plant height (95.72), number of functional leaves (53.30), leaf area (7.07), number of branches (16.67) total dry matter (20.60) plant^{-1}) and yield attributes (number of capsule (26.10), weight of capsule (3.89), number of seed (407.37) and weight of seed (1.83) plant^{-1}), Seed yield (527 kg ha^{-1}) Straw yield (2046 kg ha^{-1}), Biological yield (2573 kg ha^{-1} and harvest index (20.5) as well as oil and protein yield compared to rest of the treatments and is at par with Salicylic acid 50 PPM and Opening of furrow 30 DAS.Therefore it is suggested to spray KNO_3 @ 2% at the time of drought or at bud initiation stage to get maximum growth, seed yield, and quality in niger.

Keywords: Niger, seed yield, growth parameters, KNO_3, salicylic acid

Introduction
Niger is a minor oilseed crop belonging to family Compositae. Commercial niger seed is grown in Africa, India and other areas of southeast Asia, and the seeds are imported around the world as a popular type of birdseed. Seeds are used in human consumption in southern parts of India. In Karnataka, Andhra Pradesh and Maharashtra, niger seeds are used as an accompaniment with breads such as chapatti. Though it is considered as a minor oilseed crop both at global and national level, still it has considerable importance in rainfed conditions especially on hilly slopes and coarse textural soils.

Niger is grown in tropical and subtropical countries like India, Ethiopia, East Africa, West Indies and Zimbabwe. However, India and Ethiopia are two major niger producing countries in the world. India is a major niger growing country accounting for more than 50 percent of world niger area and production. Madhya Pradesh, Bihar, Maharashtra, Orissa, Karnataka and Tamil Nadu are the major niger producing states in India.

Soil moisture is the most limiting factor in dry farming and dry land farming situation. Water deficit cause several changes in the plants. It alters the water status by its influence on absorption, translocation and transpiration. Moisture stressed plants manifest typical reduction in leaf water potential and relative water content. Water deficit occur in the plant whenever transpiration exceeds absorption especially on hot mid days. It may be due to excessive water loss, reduced absorption of water from the soil or both. Moisture stress does not affect all the aspects of plant growth and development equally. Some processes are highly susceptible while others are far less affected. Severe water stress may result in the arrest of photosynthesis and disturbance of metabolism (Jaleel *et al.* 2008) [10]. The final yield of the crop is the integrated result of these effects of stress on water relations, photosynthesis, respiration, nutrition, growth and development. As major area under niger is in rainfed condition. Understanding of the physiological processes that occur during moisture stress or drought stress is necessary to ameliorate the stress effect either by management practices or by plant improvement. Thus increasing plant resistance to drought stress would be the most economical approach to improve agriculture productivity. Considering these aspects this experiment was planned to study the performance of different drought management practices in niger crop.

Materials and Methods

An agronomic investigation was carried out at Experimental farm, Department of Agronomy, College of Agriculture, VNMKV, Parbhani (M.S.) India, during *kharif* 2019 on clayey soil with the aim to assess the effect of different drought management practices on growth and yield of niger. The experimental site is situated at $19^0 16^{'}$ North latitude and $76^0 47^{'}$ East longitude and at 409 altitudes above sea level and has a semi-arid climate. The topography of experimental plot was fairly leveled. The soil was medium black in colour, high retentive of moisture. Soil of experimental plot was clayey in texture, medium in organic carbon, poor in nitrogen, medium in available phosphorus and high in potash and slightly alkaline in reaction. The precipitation received during crop growth period was sufficient and bright sunshine hours fluctuate slightly from normal. This climate favored for normal growth of the crop.

The experiment was laid out in Randomized block design where 10 treatments were assigned and these treatment combination were randomly replicated thrice. The treatments were allotted randomly to each replication. The treatments were T_1 – KNO_3 (2%), T_2 – Urea (2%), T_3 – DAP (2%), T_4 – Potassium sheonite (1%), T_5 – Opening of furrow 30 DAS, T_6 – 19:19:19 (1%), T_7 – Salicylic acid 50 PPM, T_8 – KCl (2%), T_9 – Water spray and T_{10} – Control. The gross and net plot size were 5.4m x 4.5m and 4.5m x 4.0 m respectively. Sowing was done on 03rd July 2019 by dibbling method at spacing of 30 cm x 10 cm. The recommended cultural practices and plant protection measures were undertaken. The recommended dose of fertilizer (40:20:20 kg N, P_2O_5, K_2O ha^{-1}) was applied as basal dose at the time of sowing through Urea, SSP and MOP were applied. The crop was harvested on 05th Oct 2019.

Results and Discussion

Growth parameters: The mean plant height of niger was significantly influenced during different growth stages of crop. Application of Potassium nitrate (KNO_3 @2%) at drought stress or at bud initiation stage (T_1) to niger crop recorded more plant height than rest of treatments and at par with Salicylic acid 50 PPM (T_7) and Opening of furrow 30 DAS (T_5). Similar trend was observed in case of number of functional leaves $plant^{-1}$ and leaf area $plant^{-1}$. The increase in growth attributes might be due to better uptake and translocation of K during drought stress as potassium controls movement of stomata and maintains electro neutrality of plant cells as well as role of nitrogen in cell division could be responsible for the increase in plant height and retaining more leaves $plant^{-1}$ and leaf area $plant^{-1}$. This result was in conformity with those reported by Kumar *et al.* (2018) [11] and Hiwale (2015) [6].

Mean number of branches were increased with application of Potassium nitrate (KNO_3 @2%) at drought stress or at bud initiation stage (T_1) recorded significantly maximum number of branches $plant^{-1}$ as compared to various treatments but it was at par with Salicylic acid 50 PPM (T_7) and Opening of furrow 30 DAS (T_5) as K maintain in internal water balance, osmotic adjustment and turgor pressure of plants and role of nitrogen in cell division and cell elongation which resulted to the production of more lateral buds that developed into branches. The similar trend was found with mean dry matter accumulation $plant^{-1}$ at harvest which might be due to role of Potassium in maintaining water balance in plants and nitrogen in nitrate encourage photosynthesis thereby enhancing the carbohydrate metabolism and hence resulted in increased dry matter accumulation, the results found were in line with those reported by Kumar *et al.* (2018) [11] and Hiwale (2015) [6].

Table 1: Growth parameters of niger at harvest as influenced by various treatments.

Treatments	Plant height (cm)	Functional leaves $plant^{-1}$	leaf area (dm^2)	Number of branches $plant^{-1}$	Dry matter (g) $plant^{-1}$
T_1 – KNO_3 (2%)	95.72	53.30	7.07	16.67	20.60
T_2 – Urea (2%)	80.35	47.47	5.36	11.40	16.56
T_3 – DAP (2%)	79.92	38.03	4.53	10.93	14.72
T_4 – Potassium sheonite (1%)	82.41	45.30	5.51	12.53	16.97
T_5 – Opening of furrow 30 DAS	89.34	49.30	6.13	14.47	19.48
T_6 – 19:19:19 (1%)	79.36	38.33	5.13	11.13	16.62
T_7 – Salicylic acid 50 PPM	93.33	49.87	6.32	15.37	20.18
T_8 – KCl (2%)	82.09	41.40	5.49	11.53	16.52
T_9 – Water spray	76.01	34.43	4.28	10.80	14.44
T_{10} – Control	69.29	31.27	3.85	9.80	13.58
SEm ±	4.00	1.89	0.39	0.66	0.98
CD at 5%	11.87	5.60	1.17	1.95	2.92
General mean (GM)	82.78	42.87	5.37	12.46	16.97

Yield and yield contributing characters

The yield attributing characters such as number of capsule $plant^{-1}$, weight of capsule $plant^{-1}$(g), number of seeds $plant^{-1}$ and weight of seed $plant^{-1}$ were reported significantly higher yield with the treatment (T_1) i.e application of Potassium nitrate KNO_3 @2%, to niger crop than rest of the treatment and it was statistically at par with Salicylic acid 50 PPM (T_7) and Opening of furrow 30 DAS (T_5). This might be due to tendency of potassium and nitrogen in accelerating growth, photosynthetic activity and efficient translocation of photosynthates. These results are in line with those reported by Singh (2017) [17]. The effect of different treatments on number of seed $capsule^{-1}$and test weight were found to be non significant.

Table 2: Yield contributing characters and Seed yield (Kg ha^{-1}) of niger as influenced by various treatments.

Treatments	No of capsules per plant	Weight of capsules per plant	No of seed per capsule	No of Seed Per Plant	Seed yield $plant^{-1}$	Test weight	Seed yield (kg ha^{-1})
T_1 – KNO_3 (2%)	26.10	3.89	23.85	407.37	1.83	5.27	527
T_2 – Urea (2%)	20.37	3.01	23.66	330.92	1.47	4.87	447

T_3 – DAP (2%)	18.88	2.96	22.13	324.15	1.35	4.53	441
T_4 – Potassium sheonite (1%)	22.29	3.23	23.14	353.97	1.58	4.80	472
T_5 – Opening of furrow 30 DAS	25.49	3.73	23.04	390.41	1.76	4.77	502
T_6 – 19:19:19 (1%)	21.32	3.12	22.13	343.95	1.54	4.70	461
T_7 – Salicylic acid 50 PPM	25.78	3.76	23.18	393.49	1.79	5.00	510
T_8 – KCl (2%)	20.64	3.09	23.87	338.58	1.51	4.90	455
T_9 – Water spray	18.35	2.91	21.96	315.79	1.31	4.20	399
T_{10} – Control	18.06	2.85	22.67	309.50	1.21	4.17	366
S.Em ±	1.12	0.17	1.05	17.76	0.08	NS	17.5
CD at 5%	3.33	0.50	NS	52.77	0.24	0.321	52.1
General mean(GM)	21.73	3.26	22.96	350.81	1.54	4.72	458.0

Seed yield kg ha^{-1} was found to be significantly influenced by different treatments. The application of Potassium nitrate KNO_3 @2%, to niger crop at moisture stress recorded significantly higher seed yield over rest of the treatments but it was at par with Salicylic acid 50 PPM (T_7) and Opening of furrow 30 DAS (T_5). Application of Salicylic acid 50 PPM (T_7) was further at par with use of Potassium sheonite (1%) (T_4) and 19:19:19 (1%)**.** This might be due to higher photosynthesis, and higher dry matter production converted into seed yield by the availability of sufficient nutrients and moisture balance by the application of various treatments. Similar findings were observed by Hiwale (2015) [6], Sarkar and Malik (2003), Sumalatha and Uppar (2019) and Kumar *et al*. (2019). The highest value of harvest index was recorded with the application of Potassium nitrate KNO_3 (2%) (T_1) which was closely followed by Salicylic acid 50 PPM (T_7) and Opening of furrow 30 DAS (T_5). The treatment of where foliar spray of various treatments was not done, however Control (T_{10}) treatment gave lowest harvest index. This was due to lower yield attributing characters, resulted to lowest harvest index.

Conclusion

Taking into consideration the result obtained from the present investigation it is concluded that the application of Potassium nitrate (KNO_3 @2%) treatment was found productive and superior recording the highest values for yield parameters as compared to all other treatments followed by the treatment on application of Salicylic acid 50 PPM and Opening of furrow 30 DAS.

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