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Response of Thiourea Application on Dehydrogenase Activity in Soil, Yield and Oil Content of Niger [*Guizotia abyssinica* (L.f.) Cass.] under Rainfed Conditions of Bastar Plateau Zone

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ABSTRACT

A field experiment was conducted on "Response of seed treatment and sprays of thiourea on growth and yield of Niger [*Guizotia abyssinica* (L.f.) Cass.] at S.G. College of Agriculture and Research Station, Jagdalpur, Bastar, Chhattisgarh during *Kharif* 2017 in randomized block design with twelve treatments and three replications. The soil of experimental field was sandy loam in texture having low pH, low organic carbon, low nitrogen, medium phosphorus, high potassium and medium in available sulphur. The highest dehydrogenase activity (16.27µg TPF/g soil/ h) at 45 DAS was recorded under seed soaking in 500 ppm thiourea for 8 hours + One spray of 500 ppm thiourea at vegetative stage (T_7) followed by Seed soaking in 500 ppm thiourea for 8 hours + One spray of 500 ppm thiourea at vegetative stage (T12) (15.93 µg TPF/g soil/ h) which were significantly higher over control (T1) (8.57 µg TPF/g soil/ h). Thiourea treatments influenced the yield of niger and the highest seed yield (359.57 kg/ha) was recorded in T_9 and the highest straw yield (1639.67 kg/ha) was recorded under T_8 (Seed soaking in 500 ppm thiourea for 8 hours + One spray of 500 ppm thiourea at flowering stage) and were significantly higher than control. The increment in oil content was 28.4 % and 26.7 %, respectively in T_9 and T_7 as compared to control.

Introduction

Niger is known as Ramtil or Kalatil in India and Noog in Ethiopia. Niger even though considered as minor oil seed crop provides satisfactory yield under poor agronomic practices like low soil fertility, low crop management and moisture stress condition. Fertilizer requirement of Niger is usually neglected and the crop is generally grown under poor or no nutrient management practices. It's grown over an area of about 2.61 lakh ha in India with production and productivity of 0.84 MT and 3.21 q/ha, respectively. In Chhattisgarh, its area is 0.63 lakh hectare with production of 0.11 MT and yield was 1.74 q/ha. In Bastar, niger was cultivated in area of 19.09 ('000) hectares with production and productivity of 6.4 ('000) Tonnes and 231.1 kg/ha, respectively

(Anonymous, 2016). Thiourea, a sulphydral compound (NH_2-CS-NH_2) is known to tolerate the deficiency of moisture (Asthir *et al.*, 2013) and is well known to enhance the source sink relationship and stimulate the translocation of photo-assimilates thereby helping in effective flower initiation, fruit and seed development and ultimately enhance productivity of the crops (Solamani *et al.*, 2001). Thiourea has 42% sulphur and 36 % of nitrogen. Thus, it behaves in physiology of plants both as a sulphydral compound and as an amino compound like urea (Garg *et al.*, 2006). It is mainly used for its dormancy breaking and germination stimulating effect. The beneficial effects of thiourea are attributed to its role in significantly increasing the net photosynthetic rates and the concentrations of total chlorophyll and starch in the leaves (Burman *et al.*, 2004). However, the merit of thiourea application on niger crop has not been investigated so far. Therefore, the present study was undertaken to explore the possibility of application of thiourea for yield improvement of niger under Bastar Plateau Zone of Chhattisgarh.

Materials and Methods

A field experiment was conducted during *Kharif* season 2017 in sandy loam soil (*Inceptisols* having 9.7% clay, 30.3% silt and 60% sand having 0.67% organic carbon, 226.46 kg ha^{-1} available N, 14.88 kg ha^{-1} available P, 317.85 kg ha^{-1} available K and 10.3 kg ha^{-1} available S) of Research Farm, S.G. College of Agriculture & Research Station (Kumhrawand) Jagdalpur, Chhattisgarh located at $19^0$05'43''N latitude and $81^0$57'60'' E longitude with an average elevation of 552 meter above mean sea level under sub-humid climate. Niger cv. JNC-9 was sown in mid of September with 12 treatments and 3 replications in randomized block design. The treatments comprised of T_1- Control, T_2- Seed soaking in 500 ppm thiourea for 8 hours, T_3- Seed soaking in water for 8 hours, T_4- One spray of 500 ppm thiourea at vegetative stage, T_5- One spray of 500 ppm thiourea at flowering stage, T_6- Two sprays of thiourea one at vegetative and one at flowering stage, T_7- T_2+T_4, T_8- T_2+T_5, T_9- T_2+T_6, T_{10}- T_3+T_4, T_{11}- T_3+T_5 and T_{12}- T_3+T_6. Fertilizer dose of 25:30:20:: N:P:K kg ha^{-1} given to each treatments including control. After 10 days of sprays i.e. at 45 and 65 DAS, soils were taken from rhizosphere soil and analyzed for dehydrogenase activity as per the procedures described by Klein *et al.*, (1971). Observations on yield attributes were taken at harvest and oil content in the seeds was determined by the Soxhlet method as described in the A.O.A.C. (1995) method no. 920.39C. The significance of the data was adjudged through analysis of variance adopting randomized block design.

Results and Discussion

Results clearly indicated that there were significant variations in dehydrogenase activities at 45 days after sowing. The highest dehydrogenase activity (16.27µg TPF/g soil/ h) was recorded under treatment seed soaking in 500 ppm thiourea for 8 hours + One spray of 500 ppm thiourea at vegetative stage (T_7) followed by Seed soaking in 500 ppm thiourea for 8 hours + One spray of 500 ppm thiourea at vegetative stage (T12) (15.93 µg TPF/g soil/ h) which were significantly higher over control (T1) (8.57 µg TPF/g soil/ h). The increment in dehydrogenase activity was 89.85 % and 85.88 %, respectively in T_7 and T_{12} as compared to control. The thiourea treatments as seed soaking and sprays triggered the growth of niger plants which in turn provide secretions through roots and organic matter in soil. These organic matter and secretions were used for energy and nutrient sources for multiplication of microorganisms. Biological oxidation of soil organic compounds is generally a dehydrogenation process carried out by specific dehydrogenases involved in the oxidative energy transfer of microbial cells (Burns, 1978). The activity is a measure of microbial metabolism and thus of the oxidative microbial activity in soils. The activity of dehydrogenase enzyme in the soil system is very important as it indicates the potential of a soil to support biochemical processes which maintain soil fertility (Joychim *et al.*, 2008). A good correlation has been reported between microbial biomass and soil dehydrogenase activity by Chander *et al.*, (1977). The beneficial effect of thiourea enhanced the availability of nutrients to soil microorganisms and creates a conducive environment for dehydrogenase activity.

After 10 days of second spray, the higher dehydrogenase activity (14.9µg TPF/g soil/ h) was recorded under seed soaking in 500 ppm thiourea for 8 hours + Two sprays of thiourea one at vegetative and one at flowering stage (T_9) followed by seed soaking in water for 8 hours + two sprays of thiourea one at vegetative and one at flowering stage (T12) (14.5 µg TPF/g soil/ h) which were significantly higher over control (T1) (7.1 µg TPF/g soil/ h). The increment in dehydrogenase activity was 109.86 % and 104.23 %, respectively in T_9 and T_{12} as compared to control. There was decrement in dehydrogenase activity in soil from 45 DAS to 65 DAS. It was due to decrease in population of soil microorganisms by the effect of moisture depletion over the period. The dehydrogenase activity at latter stage of maize crop (65 day) was drastically reduced in control (20%), T_2 (16.5%), T_7 (28.1 %) and T_9 (7.85 %) treatments as compared to that at 45 DAS. However, the intensity of activity was maintained in the treatments.

The effect of thiourea on seed yield of niger were found significant (Table 1). The highest seed yield (359.57 kg/ha) was recorded under treatment seed soaking in 500 ppm thiourea for 8 hours + Two sprays of thiourea one at vegetative and one at flowering stage (T_9) followed by Seed soaking in 500 ppm thiourea for 8 hours + One spray of 500 ppm thiourea at vegetative stage (T_7) (354.73 kg/ha), which were significantly higher over control (T_1) (300.73 kg/ ha). The increment in yield was 19.57 % and 17.96 %, respectively in T_9 and T_7 as compared to control. Similar results were obtained in horse gram (Anitha *et al.*, 2006), in cowpea (Sharma, 2000; Anitha *et al.*, 2001), in cluster bean (Bhadoria and Kushwaha, 2000) and in moth bean (Ghanshyam and Pareek, 2002). The increase in yield due to thiourea application is a clear reflection of increase in growth and yield attributes. The yield increase by the application thiourea may due to the beneficial effect of thiourea on seed germination, seedling growth, chlorophyll content, protein content, biomasss production and better dry matter partitioning as reported by Parihar *et al.*, 1988; Sahu *et al.*, 1993 and Sharma, 2002. In sulphur containing amino acids, there is a breakdown of SH group into S and H under stress situations. Thiourea helps to correct it by forming SH group; it stabilizes the enzymes and proteins. It also increases the net photosynthates and nitrate reductase activity. This may be the reason for yield increase due to thiourea application.

The effect of thiourea on straw yield (kg/ha) of niger is presented in Table 1 indicated significant variation among treatments. The higher straw yield (1639.67 kg/ha) was recorded under treatment seed soaking in 500 ppm thiourea for 8 hours + one spray of 500 ppm thiourea at flowering stage (T_8) followed by seed soaking in 500 ppm thiourea for 8 hours + Two sprays of thiourea one at vegetative and one at flowering stage (T_9) (1634.20 (kg/ha), which were significantly higher over control (T_1) (1436.62 kg/ha). There were 14.13 and 13.75 per cent increase in straw yield in T_8 and T_9, respectively over control. Similar results were observed in mustard (Dadheech *et al.*, 2009 and Dadhich *et al.*, 2015), in pearlmillet (Mehta *et al.*, 2009), in barley (Kumawat *et al.*, 2013 and Dhikwal *et al.*, 2013), in wheat (Singh *et al.*, 2013), in maize (Sumeriya *et al.*, 2014) and in coriander (Shanu *et al.*, 2013). The increase in yield due to thiourea application is a clear reflection of increase in growth attributes. The straw yield increase by the application thiourea may due to the beneficial effect of thiourea on seed germination, seedling growth, number of leaves, increase in number of branches, chlorophyll content, protein content and biomasss production as reported by Sharma, 2002. It also increases the net photosynthates and nitrate reductase activity. This may be the reason for straw yield increase due to thiourea application.

The harvest index of niger was shown in Table 1 indicated significant influence by thiourea treatments. The maximum harvest index (19.36 %) was recorded under one spray of 500 ppm thiourea at flowering stage (T_5) followed by one spray of 500 ppm thiourea at vegetative stage (T_4) (18.67 %) and seed soaking in 500 ppm thiourea for 8 hours + two spray of 500 ppm thiourea at vegetative stage and flowering stage (T_9) (18.21 %) although they remain at par with each other but significant higher over control. The increment in harvest index was 13.88 % and 9.82 %, respectively in T_5 and T_4 as compared to control.

The enhancement in harvest index of niger may be due to better dry matter partitioning as reported by Parihar *et al.*, (1988), Sahu *et al.*, (1993) and Sharma (2002).

Table.1 Effect of thiourea on yield of niger

Treatment	Seed yield (kg/ha)	Straw yield (kg/ha)	Harvest index (%)
T_1- Control	300.73	1436.62	17.00
T_2- Seed soaking in 500 ppm thiourea for 8 hours	330.68	1504.30	17.48
T_3- Seed soaking in water for 8 hours	316.23	1505.91	16.88
T_4- One spray of 500 ppm thiourea at vegetative stage	336.73	1516.00	18.67
T_5- One spray of 500 ppm thiourea at flowering stage	337.92	1519.05	19.36
T_6- Two sprays of thiourea one at vegetative and one at flowering stage	344.87	1582.17	17.45
T_7- T_2+T_4	354.73	1595.73	18.03
T_8- T_2+T_5	349.13	1639.67	17.98
T_9- T_2+T_6	359.57	1634.20	18.21
T_{10}- T_3+T_4	338.37	1544.40	17.99
T_{11}- T_3+T_5	343.20	1563.87	17.99
T_{12}- T_3+T_6	349.07	1589.47	17.98
CV %	9.21	7.59	3.93
CD (5%)	52.81	199.50	1.19
CD (1%)	71.78	271.15	1.62

Table.2 Effect of thiourea on oil content of niger and Dehydrogenase activity in soil

Treatment	Oil		Dehydrogenase activity (µg TPF/g soil/h)	
	Content (%)	Yield (kg/ha)	At 45 DAS	At 65 DAS
T_1- Control	30.30	90.8	8.57	7.1
T_2- Seed soaking in 500 ppm thiourea for 8 hours	34.80	114.4	11.77	10.1
T_3- Seed soaking in water for 8 hours	32.70	103.7	9.30	7.6
T_4- One spray of 500 ppm thiourea at vegetative stage	35.40	119.5	12.90	11.2
T_5- One spray of 500 ppm thiourea at flowering stage	34.80	117.8	8.23	8.9
T_6- Two sprays of thiourea one at vegetative and one at flowering stage	36.40	125.1	12.40	12.6
T_7- T_2+T_4	38.40	135.4	16.27	12.7
T_8- T_2+T_5	35.90	126.6	11.50	11.3
T_9- T_2+T_6	38.90	139	16.07	14.9
T_{10}- T_3+T_4	35.70	121.4	12.80	11.1
T_{11}- T_3+T_5	35.10	120	10.10	9.9
T_{12}- T_3+T_6	38.40	133.3	15.93	14.5
CV (%)	13.3	14.7	28.87	24.35
CD (5%)	8.00	30	5.94	4.53
CD (1%)	10.90	40.8	8.08	6.16

The effect of thiourea on oil content (%) is presented in Table 2 indicated significant variation among treatments.

The higher oil content (38.90 %) was recorded under seed soaking in 500 ppm thiourea for 8 hours + Two sprays of thiourea one at vegetative and one at flowering stage (T_9) followed by seed soaking in 500 ppm thiourea for 8 hours + one spray of 500 ppm thiourea at vegetative stage (T_7) and seed soaking in water for 8 hours + two sprays of thiourea one at vegetative and one at flowering stage (T_{12}) (38.40%) but they remain at par with each other and have significant higher oil content as compare to control plot (T_1) (30.30 %). The increment in oil content was 28.4 % and 26.7 %, respectively in T_9 and T_7 as compared to control.

Similar findings were reported by Pandey *et al.*, (2013) in Indian mustard. The increase in oil yield was attributed due to conversion of unloaded sucrose inside the pod into triose phosphate which finally gets converted into pyruvate (PYR) either through glycolytic pathway or phosphoenol pyruvate carboxylase (PEPC) mediated C4 pathway.

The first step of PEPC pathway involves the carboxylation of PEP into oxaloacetate (OAA) which is then converted to malate (MAL). The MAL gets decarboxylated via $NADP^+$ linked malic enzyme to PYR and CO2. The PYR formed, through either of the pathway, directed towards fatty acid synthesis through acetyl-CoA carboxylase (ACC). The additional carbon fixed through PEPC pathway is termed as pod or silique wall photosynthesis and is considered as important for regulating seed oil content in Brassica species (Hua W *et al.,* 2012). The increased level of metabolites (PEP, MAL and PYR) and higher enzyme activity (PEPC) together indicated the efficient pod photosynthesis in TU treated pods, especially at initiation (2 d) and rapid grain filling (5 d) stage. This was also coherent with higher ACC activity required for maintaining the high rate of oil biosynthesis. Both PEPC (O'Leary B *et al.,* 2011) and ACC (Dietz KJ and Pfannschmidt T, 2011) are known to be redox regulated with maximum activity observed under reducing environment. This might be the reason behind their enhanced activity in TU treated pods. All these changes were ultimately reflected in the form of increased reserve food material (both oil and protein).

The effect of thiourea on oil yield recorded significant variation as shown in Table 2. The highest oil yield (139 kg/ ha) was observed in seed soaking in 500 ppm thiourea for 8 hours + Two sprays of thiourea one at vegetative and one at flowering stage (T9) followed by seed soaking in 500 ppm thiourea for 8 hours + one spray of 500 ppm thiourea at vegetative stage (T_7) (135.4 kg/ ha), seed soaking in water for 8 hours + Two sprays of thiourea one at vegetative and one at flowering stage (T12) which were significantly higher over control (T_1) (90.8 kg /ha). The increment in oil yield was 53.1% and 49.1 %, respectively in T_9 and T_7 as compared to control. The increase in total oil yield has been due to increase in seed yield and seed oil content.

The merit of thiourea application is well documented in different crops, but the present study revealed that thiourea application gave the good response. Thus, a resource-deficient farmer of the bastar plateau zone may achieve good seed recovery and oil yield in niger by seed soaking and foliar spray of thiourea (500 ppm).

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References

A.O.A.C, 1995. Official Methods of Analysis 16th Education Journal Association of Official Analytical.

Anitha, S., Purushothaman S.M. and Sreenivasan, E. (2001) In: National Symposium on Pulses and Oilseeds for Sustainable Agriculture, 29-31 July, 2001, Tamil Nadu Agricultural University, Coimbatore, pp. 102.

Anitha, S., Purushothaman S.M. and Sreenivasan, E. 2006. Response of horse gram to thiourea application under rainfed conditions. Legume research. 29(2): 146-149.

Anonynous. 2016. Government of India Oil Seed Divison.

Asthir, B., Thapar, R., Farooq, M. and Bains, N.S. 2013. Exogenous application of thiourea improves the performance of late sown wheat by inducing terminal heat resistance. International Journal of Agriculture and Biology, 15: 1337–1342.

Bhadoria, R.B.S. and Kushwaha, H.S. 2000. In: National Seminar on Agriculture Scenario Challenges and Opportunities at College of Agriculture. Gwalior, 11-12 November, 2000 pp. 80-81.

Burman, U., Garg, B.K. and Kathju, S. 2004. Interactive effects of thiourea and phosphorus on clusterbean under water stress. Biologia Plantarum, 48 (1): 61-65.

Burns RG. 1978. Enzyme activity in soil: some theoretical and practical considerations. In: Burns s RG (ed.) Soil enzymes. Academic, London, pp 295–340.

Chander K, Goyal S, Mundra, MC and Kapoor KK. 1977. Organic matter, Microbial biomass and enzyme activity of soilunder different crop rotations in the tropics. Biology and Fertility of Soils, 24: 306-310.

Dadheech, R.C., Jat, R. P. and Sumeriya, H. K. 2009 Response of mustard [*Brassica juncea* (L.) Czern and Coss.] to organic and inorganic sources of nutrients, gypsum and thiourea. Haryana Journal of Agronomy, 25(1/2): 76-78.

Dhikwal, S.R. Kumawat, S.M. Das, S. and Jat, B.L. 2013. Effect of bioregulators application on productivity of barley [*Hordeum vulgare* (L.)] in arid condition of western Rajasthan. Forage Research, 38(2): 106- 111.

Dietz, K.J., and Pfannschmidt, T. 2011. Novel regulators in photosynthetic redox control of plant metabolism and gene expression. Plant Physiology, 155: 1477–1485.

Garg, B. K., Burman, U. and Kathju, S. 2006. Influence of thiourea on photosynthesis, nitrogen metabolism and yield of clusterbean (*Cyamopsis tetragonoloba* (L.) Taub.) under rain fed conditions of Indian arid zone. Plant Growth Regulation, 48: 237–245.

Ghanshyam and Pareek, B.L. 2002. In: Extended Summaries. International Agronomy Congress, IARI, New Delhi, 1(2): 455-456.

Hua W, Li RJ, Zhan GM, Liu J and Li J. 2012. Maternal control of seed oil content in *Brassica napus*: the role of silique wall photosynthesis. Plant Journal, 69: 432-444.

Joychim HJR, Makoi P and Ndakidemin A. 2008. Selected soil enzymes: examples of their potential roles in the ecosystem. African Journal of Biochemistry.7: 181-191.

Klein, DA., Loh, T.C., and Goulding, RL. 1971. A rapid procedure to evaluate dehydrogenase activity of soils low in organic matter. Soil Biology and Biochemistry. 3: 385-387.

Kumawat, P.D. 2004. Response of india mustard (*Brassica juncea* L.) to seed treatment and foliar spray of sulphuric acid under varying levels of irrigation, Ph. D. Thesis, S.K. Rajasthan Agricultural University, Bikaner.

Mehta, A. C., Khafi, H. R., Bunsa, B. D., Dangaria, C. J. and Davada, B. K. 2009. Effect of different drought ameliorating agro-chemicals and cultural practices on productivity and profitability of pearlmillet [*Pennisetum glaucum* (L.)]. Research on Crops, 10(2): 234-236.

O'Leary B, Park J. and Plaxton, WC. 2011. The remarkable diversity of plant PEPC (phosphoenolpyruvate carboxylase): recent insights into the physiological functions and post-translational controls of non-photosynthetic PEPCs. Biochemistry Journal, 436: 15–34.

Pandey, M., Srivastava, A.K., D'Souza, S.F. and Penna, S. 2013. Thiourea, a ROS Scavenger, Regulates Source-to-Sink Relationship to Enhance Crop Yield and Oil Content in *Brassica juncea* (L.). www.plosone.org. 8(9): e73921.

Parihar, G.N., Sahu, M.P. and Joshi, N.L. 1988: Nitrogen, sulphur and thiourea nutrition of pearl millet (*Pennisetum glaucum* (L.) R. Br.). II. Effect on yield and yield components. Ann. Arid Zone. 37: 59-67.

Sahu, M.P., Solanki, N.S., Dashora, L.N.1993: Effect of thiourea, thiamine and ascorbic acid on growth and yield of maize (*Zea maize* L.). Journal Agronomy of Crop Science. 171: 65-69.

Shanu, Naruka, I.S., Singh, P.P. Shaktawat, R.P.S., and Verma, K.S. 2013. Effect of seed treatment and foliar spray of thiourea on growth, yield and quality of coriander (*Coriandrum sativum* L.) under different irrigation levels.

International Journal of Seed Spices. 3(1): 20-25

Sharma, O.P. 2002. Effect of levels and sources of sulphur in conjucation with growth substances on productivity of cluster bean (*Cymopsis tetragonolobas* L.) in arid ecosystem. Ph.D. Thesis, Maharana Pratap University of Agriculture and Technology, Udaipur.

Sharma, S.L. 2000. In: National Symposium on Agronomy: Challenges and Strategies for the New Millennium. GAU Campus, Junagarh (Gujarat), pp. 319.

Singh, Surendra, Singh, Harphool, and Choudhary, Ramniwas, 2013. Heat stress management in late sown wheat (*Triticum aestivum*) under climate change scenario. Annals of Agricultural Biotechnology Research, 18(2): 135-138.

Solamani, A., Sivakumar, C., Anbumani, S. Suresh, T. and Arumugam, K. 2001. Role of plant growth regulators on rice production: A review. Agriculture Review, 23: 33-40.

Sumeriya, H. K., Panchu Ram, Solanki, N. S. and Kumar, Rakesh. 2014. Influence of fertility levels and foliar sprays of thiourea on growth, yield, nutrient uptake and economics of quality protein maize (*Zea mays* L.) under southern Rajasthan condition. Annals of Agricultural Biotechnology Research, 19(2): 230-233.

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