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Effect of Thiosemicarbazides on The Germination Pattern of Wheat (Triticum)

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Abstract
Thiosemicarbazides have found to contain antimicrobial, antimycobacterial activity, antiviral activities against various virus, bacteria and fungi strains. The objective of the study was to determine the seed germination and physiological maturity stage of wheat (triticum). Speed of germination index, Vigor index, root length, shoot length and dry matter were determined after 10 days treatment. These factors are affected by different condition.
Keywords: Speed of germination index, vigor Index, Brassica campestris (L.), Root/shoot length.

Introduction

Plant physiology is a fundamental biological science. Its recent achievements are of worldwide significance. The plants are a unique source of organic compounds and oxygen for the planet, providing the biological resources for existence of the oxygen-dependent heterotrophic organisms and maintenance of the defence ozone shield. Plant physiology is also the base of development of methods for the control of plant physiological and biological and biochemical processes. Biological science is concerned with the general pattern governing life process of plant. Plant physiology studies the ways in which plants absorb minerals and water, grow and develop bear flower and fruits. It also deals with mineral nutrition and photosynthesis, respiration biosynthesis and accumulation of substances which together enable plants to grow and reproduce themselves. By revealing the dependence of the life process on environmental condition, plant physiology serves as theoretical basis for increasing the total productivity of plant, improving their nutrition value, raising the quality of their tissue and organs for use in industry. Research in plant physiology provides a scientific basis for the rational planting of crop in relation to soil and climatic condition. An importance event in modern plant physiology was the discovery of photorespiration, a specialisation function of energy metabolism in green plants consisting in the light-induced absorption of oxygen by green cell, accompanied by the realise of CO2. The efficient use of light, the net productivity of photosynthesis and the total productivity of a plant are apparently related largely to photorespiration [1-2]. Seed germination is the processes by which a seed embryo develops into a seedling. It involves the reactivation of metabolic pathways that lead to growth and emergence of the radicals or seed root and plumule or shoot. The emergence of seedling above the soil surface is the next phase of plant growth and is called seedling establishment. [3] Three fundamental conditions must exist before germination can occur.

(1) The embryo must be alive called as seed viability.

(2) Any dormancy requirements that prevent the germination must b over come.

(3) It very necessary that proper environmental condition must exists for germination.

Seed viability is the ability of the embryo to germinate and is affected by number of different condition. Some plants do not produce seeds that have functional complete embryos, or the seed may have no embryo at all, often called empty seeds. Predictor and pathogen can damaged and kill the seed while it is still in the fruit. Environmental condition like flooding or heat can kill the seed before or during germination. The age of seed affects its health and germination ability, since the seed has a living embryo, over period of time, cells die and cannot be replaced. Some seeds can live for a long time before germination while other can survive for a short period after dispersal before they die. Seed vigour is a measure of quality of seed and involves viability of the seeds, the germination percentage, germination rate and the strength of the seedling produce. The germination percentage simply the proportion of seeds that germinate from all the seeds subject to write condition for growth. The germination rate is the length of time it takes for a seeds to germinate. Germination percentage and rate are affected by seed viability; dormancy and environmental affect that in plant on the seed and seedling. Future agricultural research

programs will continue, as in the present, to have as their major goals for the production of new and better varieties and strains of crops; the improvement of plant protection against insects, diseases and weeds; the control of soil fertility and an increase in mechanization of efficiency. But, in addition, there will be a sharp intensification of demands of plant physiologists not only to supply basic information regarding how plants grow and develop but also to undertake research programs designed specifically to increase yields of plant products. Such a vast demand of increasing plant growth necessitates concentration on the study of Thiosemicarbazides for studying germination pattern too

Materials and Methods

Synthesis of compound:

On the basis of Literature survey, it is found that Thiosemicarbazides are prepared by different routes [4-5]. The present work describes the synthesis of Thiosemicarbazides as suggested by Bhaskar [6].

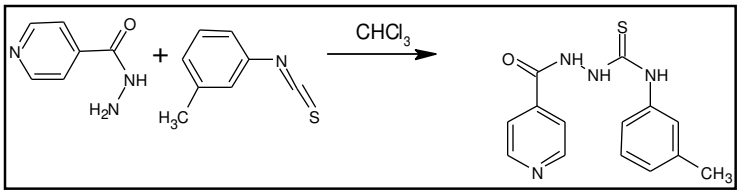
Synthesis of M3 (1- γ -picolinoyl-4-m-tolyl thiosemicarbazides):

Step I– Synthesis of m-Tolyl isothiocyanate:

54 g (0.71 mole) of carbon disulfide and 90 ml (1.3mole) of concentrated aqueous ammonia were placed in a 500 ml round-bottomed flask, fitted with a mechanical stirrer and surrounded by an ice-salt cooling bath. The stirrer was started and 56 g (0.6 mole) of m-Toludiene was run into the mixture from a separatory funnel at such a rate that the addition was completed in about twenty minutes. The stirring was continued for thirty minutes after all the aniline had been added and then the reaction mixture was allowed to stand for another thirty minutes. During this time a heavy precipitate of ammonium phenyldithiocarbamate separated out. The salt was dissolved in 800cc of water and transferred to a round-bottomed flask. Solution of 200g (0.6mole) of lead nitrate in 400 ml of water was added into it. Lead sulfide separated as a heavy brown precipitate which soon turned black. The mixture was then distilled with steam into a receiver containing 5-10 ml of 1 N sulphuric acid as long as any oil came over. Distillate was collected. The product (m-Tolyl isothiocyanate) was separated from the water. The yield was recorded.

Step II– Synthesis of 1- γ -picolinoyl-4-m-tolyl thiosemicarbazides:

Isoniazide, m-Tolyl isothiocyanate and chloroform as a solvent were refluxed for 1.5 h. On distilling off chloroform a solid residue was obtained. It was washed with petroleum ether. It was crystallized from ethanol; a colourless crystalline solid was obtained m. p. 184 oC



Synthesis of M4:

Step I– Synthesis of o-Chloro phenyl isothiocyanate:

54 g (0.71mole) of Carbon Disulfide and 90cc (1.3 mole) of concentrated aqueous ammonia were placed in a 500cc round-bottomed flask which was fitted with a mechanical stirrer and surrounded by an ice-salt cooling bath. The stirrer was started and 56 g (0.6 mole) of o-Chloro aniline was run into the mixture from a separatory funnel at such a rate that the addition was complete in about twenty minutes. The stirring was continued for thirty minutes after all the aniline had been added and then the reaction mixture was allowed to stand for another thirty minutes. During this time a heavy precipitate of ammonium phenyldithiocarbamate separated out. The salt was dissolved in 800 ml of water and transferred to a round-bottomed flask. The solution was added with constant stirring a solution of 200 g (0.6 mole) of lead nitrate in 400 ml of water. Lead sulfide separated as a heavy brown precipitate which soon turned black. The mixture was then distilled with steam into a receiver containing 5-10 ml of 1 N sulphuric acid as long as any oil came over. Distillate was collected. The product (o-Chloro phenyl isothiocyanate) was separated from the water and yield was recorded.

Step II– Synthesis of 1- γ -picolinoyl-4-O-Chloro phenyl thiosemicarbazide:

Isoniazide, o-Chloro Phenyl isothiocyanate and chloroform as a solvent were refluxed for 1.5 h.

On distilling off chloroform a solid residue was obtained. It was washed with petroleum ether. It was crystallized from ethanol; a colourless crystalline solid was obtained having m. p. 162 oC.

Selection of System:

In general practice, various chemicals are used in agriculture as an important ingredient of various pesticides, insecticides, fertilizers, etc. to improve the crop yield. Amongst several economically important plants, Wheat (the Triticum spp.) is cultivated worldwide. Globally, wheat is the most-produced food among the cereal crops after rice. Wheat (the Triticum spp.) grain is a staple food used to make flour for leavened, flat and steamed breads; cookies, cakes, breakfast cereal, pasta, noodles; and for fermentation to make beer, alcohol, vodka or even biofuel. Among the various seeds of cereals, the wheat grains provide more food to over one thousand million human beings of this earth than any other plant or animal products. According to an estimate , about one fourth supply of human energy comes from the wheat grains in the United States; It is therefore, most appropriate that these wheat grain must be protected at all stages of handling, from the time of harvest, through storage, transportation and processing, up to the time they are ready to be consumed.Such a widespread use of (Tritium spp,)in daily life is persuasive to study its response against H2O, 10% DMF, M3 M4,regarding physiological processes in general and particularly germination as a vital process for the growth of plants. For Germination, healthy seeds of Tritium of same generation were taken and thoroughly washed using doubly distilled water. The germination trays sterilized with 0.01% of HgCI2 for 2 minutes and were prepared by keeping 25 seeds in folded blotting paper for treatment. The test solutions of 0.001 M were added. A controlled set was similarly run using distilled water. The present germination was recorded daily up to ten days. The protrusion of radial through seed coat was taken as the criteria of seed germination. The speed of germination index (SGI) was calculated as [7-9].

SGI = (10g + 9g + 8g + 7g + 6g + 5g + 4g + 3g + 2g)

Here 'g' represents number of germination seeds after 24 hours. For the study of growth and chlorophyll content, similar conditions were kept and estimation of total chlorophyll, chlorophyll-a, chlorophyll-b were made according to Jahagirdar etal.[10] and expressed in mg/l.

Chlorophyll (total) (mg/l) = 0.0202(O.D.) 645 + 0.00802 (O.D.) 663

Chlorophyll-a (mg/l) = 0.0127(O.D.) 663 – 0.00269 (O.D.) 645

Chlorophyll-b (mg/l) = 0.0229(O.D.) 645 – 0.00488 (O.D.) 480

On the same day, root length and fresh weight of seedlings were measured. The dry weight was measured by keeping fresh plantlets in oven first at 70 OC and later at 100 OC to obtain a constant weight [11]. Vigour index was determined according to Abdul-Baki Anderson et al. [12] as:

Vigour index = percent germination [(root length + shoot length) mm].

RESULTS AND DISCUSSION

Experimental and Computed Data:

Table-I: Chlorophyll and Dry Matter Content for Controlled and Treated plants.

System	Chlorophyll total (mg/l)	Chlorophyll-a (mg/l)	Chlorophyll-b (mg/l)	Dry Matter
Water	4.25786×10-4	3.27931×10-4	7.557946×10-4	1.65
10% DMF-Water	2.02908×10-4	4.2078×10-4	6.2962×10-4	1.9
M3	6.51876×10-4	3.21664×10-4	9.79326×10-4	2.6
M4	1.57259×10-4	3.14729×10-4	6.0722×10-4	1.93

Table-II: Percent Germination, speed of Germination Index and Vigour Index for Controlled and Treated plants.

System	Percent Germination	SGI	Vigour Index
Water	92	205	2403.16
10% DMF	88	182	1968.58
M3	100	204	3068
M4	84	153	1418.76

Table-III: Root Length, Shoot Length and Root/Shoot for Controlled and Treated Plants.

System	Root Length	Shoot Length	Root/ Shoot
Water	11.63	14.58	0.7976
10% DMF	8.70	13.67	0.6364
M3	11.6	19.08	0.6079
M4	6.85	10.04	0.6822

Early attempts have been made by Mahmooda Buriro et al.[13] to study the effect of temperature on triticum seed germination. In the present investigation, effect of thiosemicarbazide on the chlorophyll, dry matter, percent germination, SGI, vigour index, root length, shoot length, root shoot ratio of Triticum aestivum (L)have been studied.

Chlorophyll:

Basically, among the smallest group of coordinating pigment molecules necessary to affect a photochemical act, the most important pigments involved in photosynthesis are chlorophyll and carotenoid. There are five types of chlorophyll viz. a, b, c, d and e amongst which only a and b are present in higher plants. Chlorophyll a appears blue green in transmitted light but reddish in reflected light and is the principal pigment involved in trapping the light of wavelength 670 nm. Chlorophyll b is yellowish green in transmitted light but reddish in reflected light and traps the light of wavelength 645 nm. These photosynthetic pigments were found affected in triticum by the treatment. It can be seen from Table–I that for M3, chlorophyll content is found to be increased as compound to M4, H2 O, 10% DMF.

Dry Matter:

Growth of cells is sometimes measured as an increasing cell number or the fresh weight of packed cells. However, fresh weight is not always a reliable measure because most of the plant tissues approximately contain 80% water. Water content is highly variable and fresh weight will fluctuate widely with changes in the water status of the plant. Therefore, a more reliable parameter, dry organic matter in the plants synthesized during various metabolic processes. A vital process, photosynthesis is responsible for the production of organic matter, which is available as dry matter, when the moisture content has been evaporated. It can be seen from Table–I that the dry matter was increases in case of M3 as compared to M4, H2O, 10% DMF which may be due to the increases in chlorophyll content.

Percent Germination:

The development of majestic oak tree from a small acorn requires a precise and highly ordered succession of events. Starting from a single fertilized egg, plant cells divide, grow and differentiate into increasingly complex tissues and organs. These events along with their underlying biochemistry and many factors that either impose or modulate on unfailing an orderly progression through the life cycle constitute development, i.e., seed germination. If any cycle can be said to have a beginning in plants, the beginning would be germination of seed. The seed is a convenient place to begin because seeds are quiescent or resting organs that represent a normal hiatus in life cycle. When the conditions are appropriate, the seed will renew its growth and germinate. Such an important phenomenon will be affected by different conditions [14]. It is clear from Table–II that percent germination increases by the treatment of M3 as compared to H2O, M4,10 DMF%.

Speed of Germination Index (SGI):

The response of seeds to hydration varies. This variation is in the initiation of germination or emergence. The seeds may start emerging on the first day or it requires some period for necessary adaptation. This time requirement can be studied by determining the speed of germination on the basis of the day of starting the germination multiplied by suitable factors. As in the percent germination the treatment by M3 should increases over control. The SGI was also increased for M3.

Vigour Index:

The seed quality is having the synonymous terms seed vigour in literature. On the basis of seed vigour, one can predict about the seed germination and yield of grain. The seed vigour may be improved by using fertilizers, irrigation, pest control and soil management. Whatever chemicals are used to improve the seed vigour contain different groups which can negatively affect the basic purpose of that chemical. As reported by earlier workers [15-16], in the present investigation also, it has been observed from Table–II that, vigour index was effectively increased by the treatment of M3.

Root Length, Shoot Length and Root-Shoot Ratio:

Germination starts when the seed shows emergence phase of growth which begins with penetration of embryo from the seed coat and ends with the development of root and shoot

system. The rate and extent of elongation is subjected to a variety of controls including nutrition, hormones and environmental factors [17-18]. Though the root and shoot developments start within a fraction of time but the further developments may vary according to the nutrients required for the development of root and shoot independently. Therefore, root and shoot lengths differ. Table–III clearly indicates that, root length and shoot length show tremendous increased by treatment of M3.

SUMMARY AND CONCLUSIONS:

These photosynthetic pigments were found affected in Triticum spp, by the treatment. It can be seen from Table–I that for M3, chlorophyll content is found to be increased as compound to M4, H2 O, 10% DMF. It can be seen from Table–I that the dry matter was increases in case of M3 as compared to M4, H2O, 10% DMF which may be due to the increases in chlorophyll content. It is clear from Table–II that percent germination increases by the treatment of M3 as compared to H2O, M4, 10 DMF%. As in the percent germination the treatment by M3 should increases over control. The SGI was also increased for M3. it has been observed from Table–II that, vigour index was effectively increased by the treatment of M3. Though the root and shoot developments start within a fraction of time but the further developments may vary according to the nutrients required for the development of root and shoot independently. Therefore, root and shoot lengths differ. Table–III clearly indicates that, root length and shoot length show tremendous increased by treatment of M3. The treatment showed increase over control. Percentage germination, speed of germination, vigour index, and chlorophyll content was increase on the treatment by the solutes M3 and M4. The value for all the parameters is larger in case of M3 as compared to M4. This concludes that the compound M3 shows positive effect as compared to M4.

Refrences:

L. Kursanov, Peredvizhenie Veshchestv Rastenii, Moscow, (1976).

Rubin, Kurs Fiziologii Rastenii, 4th ed. Moscow, (1976).

H. Michael & P. Halmer, “The Encyclopaedia of Seeds: Science, Technology and Uses, Wallingford, UK, CABI, 224 (2006).

F. B. Dains, R. Q. Brewster & C. P. Olander, Org. Synth., 1, 447,(1941); 6, 72 (1926)

J. C. Craig, M. Moyle & R. A. Whitel, Org, synth., 4, 700(1963); 36,56 (1956).

S. Bhaskar, Ph. D. Thesis submitted to Amravati uni, Amravati (2002).

W. Darnall & E. R. Brinhaum, J. Bio. Chem., 12, 489 (1973).

M. Ashraf, N. Akhtar, F. Tahira & F. Nasim, Pak. J. Biol. Sci., 2 (4) 1594 (1999).

P. L. Bruckner & R. C. Frohberg, Int. J. Agric. Bio., 2, 300 (2002).

D. V. Jahagirdar, “Experiment in Chemistry”, 1st Ed., Himalaya Publishing House (1994).

S. M. Basara, N. Ahmad, K. Rehman & N. Iqbal, Int. J. Agric. Biol., 4 127 (2002).

Abdul-Baki & J. D. Anderson, Crop Sci., 13, 630 (1973).

Buriro, M., F.C. Oad, M.I. Keerio, S. Tunio, A.W. Gandahi, S.W.U. Hassan and S. M. Oad. Sarhad J. Agric. 27(4): 539-543

S. U. Siddiqui, A. Aliand & F. Chaudhary, Pak. J. Bot., 40 (3), 1121 (2008).

Rajasubramanian, P. Sundaramoorthy, L. Baskaran, K. S. Ganesh, A. Chidambaram & M. Jeganathan, Int. Multidiscip. Res. J., 1 (1), 25 (2011).

R. Jain, S. Solomon, A. K. Shrivastava & A. Chandra, Acta. Physiol. Plant., 33 (30), 905 (2011)

L. Jing, L. Shi-Qing, L. Yi & C. Xiao-Li, Plant Soil Environ., 255 (7), 273 (2009).

P. Zhao, G. C. Sun, X. P. Zeng, X. A. Cai & S. L. Peng, Acta. Ecologica. Sinica. 23, 1386 (2003).

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