Allelopathic effects of *Datura stramonium* on seed germination and seedling vigour of *Triticum aestivum* (variety *GW 273*).

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Abstract

Wheat is cultivated worldwide as a cash crop, it produces a good yield per unit area, grows well in a temperate climate even with a moderately short growing season. Majority of India's population eat food stuffs made from wheat, moreover our country is the second largest wheat producer in the world. *Datura stramonium* is a naturally fast growing weed containing tropane alkaloids (atropine, hyosyamine, and scopolamine) and its presence has been sighted along the boundaries and hedges of the cultivating fields of wheat. The present study focuses on exploring the allelopathic interactions of *Datura stramonuim* on *Triticum aestivum* (variety GW273) seed germination and seedling vigour. Aerial parts of the plant *Datura stramonium* were dried in the oven at 80 degrees for 24 hours then crushed, mixed with distilled water and allowed to stand for 72 hours in water bath at 25 (\pm 2) degrees followed by filtration using whatman's filter paper no.1.Four dilutions of different ratios were prepared for the ongoing study. The extracts pose significant and varying allelopathic effects on seed germination and seedling vigour of wheat.

Key words: Allelopathic interactions, GW 273, tropane alkaloids, boundaries and hedges.

Introduction

Allelopathy is a biological phenomenon by which an organism produces one or more biochemical's that influence the growth, survival and reproduction of other organisms. These biochemicals are known as allelochemicals. These chemicals are released from plant parts by leaching, root exudation, volatilization, residue decomposition and other processes in both natural and agricultural systems. (Theophrastus 300 B.C, Yang and Tang first century A.D, De Candolle 1832, Schreiner and Reed 1907-1909). Allelopathy was first widely studied in forestry ecosystems. Allelopathy involves chemical interaction at all levels of complexity, from microorganisms to higher plants, and is inextricably interwoven into ecological phenomenon. In this context competition for food and living space is often carried out chemically: all sorts of antibiotics, toxins, germination and growth inhibitors, or stimulants may be released for these purposes, adsorbed by the surrounding soil or upon direct action through the air. Allelochemicals are used by plants and micro-organisms to manipulate partners, competitors and ecosystems.

Knowledge of the chemistry and biology of the allelochemicals provides many opportunities for practical application in biological control methods. Furthermore the allelopathic interactions are not restricted to the terrestrial organisms but are also very common in aquatic organisms. Some of these active compounds (allelochemicals) exhibit exiting physiological properties that are of higher medical and agrochemical interest.

Now-a-days advancement in the research field has been made to study the allelopathic interactions between crops and weeds, crops and crops, both stimulatory and inhibitory. Various researchers have studied the injurious and harmful effects of allelochemicals on crops some vital contributors are Oudhia and Tripathi(1998), Oudhia et.al (2000), Kruse et.al (2000), Verma and Rao (2006), Setia et.al (2007).

Weeds compete for light, nutrients, moisture and space with the crop and thus cause severe losses to yield. Losses in wheat due to weeds range 17-25% (Shad, 1987) and in monetary terms it may be as high as Rs.28 billions (Hassan and Marwat, 2001). *Datura stramonium* is a natural weed belonging to the family Solanaceae, commonly known as Thorn apple, Jimsonweed, Devil's trumphet. It is a bushy smooth, light dull green in color. It contains tropane alkaloids mainly atropine, hyocyamine, scopolamine. Many studies conducted in the past have revealed that the alkaloids present in the plant are harmful to crops, Manske (1950), Mothes (1995), Inderjit & Dakshini (1998a), Oudhia et.al (1996, 1998, and 1999).

The wheat variety *GW 273* was prepared by Gujarat agricultural university vijapur and is especially recommended for the ecology of central zone comprising of Madhya Pradesh. Being a certified variety it is resistant to diseases such as leaf and stem rust, with a moderate growing season of 113 days.

Materials and Methods

Aerial parts of the plants of *Datura stramonium* were collected and dried in hot air oven for 24 hours at 80 degrees. After drying the plants were crushed in powdered form manually using mortar and pistil. Four concentrations 1:10, 1:20, 1:30, 1:40, were made on the basis of weight and volume I.e. (10 gm of plant material added in 100 ml of distilled water). The materials (plant material and distilled water) were mixed and put into a conical flask with its mouth closed and was allowed to stand in water bath for 72 hours at a constant temperature of 25 degrees. Followed by filtration process in two steps, in the first step muslin cloth was used and later the filtrate was allowed to pass through Whatman's filter paper no.1. The seeds of wheat variety GW 273 were collected from the agricultural university hoshangabad (Madhya Pradesh). The seeds were washed five times in running tap water to remove the impurities and afterwards surface sterilized with 1% Of mercuric chloride solution later the seeds were washed thoroughly three times in distilled water. The seeds were kept in distilled water over night before the start of experiment.

Selected number of seeds of *Triticum aestivum* GW 273 exactly 10 per Petri plate were kept on double layer of filter paper for germination test. Equal sized plates were taken for the study. The treatment was carried out using one controlled (T0) and four (T1, T2, T3, T4) different concentrations of the plant material (*Datura stramonium*) prepared. Three replicates of each treatment were taken in consideration. 20 ml of distilled water was added to the control replicates, and 20 ml of extract was applied to each replicate of different plant concentrations (1:10, 1:20, 1:30, 1:40) respectively. The replicates were supplied time to time with distilled water in order to retain the moisture content so that the seeds may not become dry and dead. After seven days the replicates were again given 20 ml of the extract (1:10, 1:20, 1:30, and 1:40) concentrations prepared previously. The observations were recorded accordingly.

Results and Discussion

Allelopathic activity of *Datura stramonium* was confirmed on seed germination of wheat variety GW 273. The study showed that the alkaloids present in *Datura stramonium* pose varying impacts on overall germination process when compared with the untreated seed replicate observations. Germination was inhibited as well as delayed according to the extract concentrations, the extracts of all the weeds produced significant allelopathic effects on germination and seedling vigour of wheat. At 3 DAS, all extracts produced comparable germination with control (water). At higher level of treatment concentration the plant extract (1:10) resulted in 0% germination after 15 days followed by 20 % in (1:20) while as in the treatment extract of 1:30 the percentage of germination was 43.333%, and at 1:40 germination percentage 83.333% was recorded.

The most important thing which witnessed was the suppressed growth of constant number of seeds during the last three observations. The study reports a minimum of 0% (complete failure) of seed germination in treatment type T1 (1:10) and the maximum of 83.333% of seed germination in treatment type (1:40), one interesting fact observed was that the extract induced strong stimulatory effect on root and shoot elongation as well as on the number of secondary adventitious roots in treatment concentration type T3 (1:30) and T4 (1:40) when compared with that of control replicates. Similar type of study has been carried out in the past by Oudhia et.al 1998, 1999. In which maximum root-shoot elongation was witnessed in winter wheat induced by *Datura stramonium* at lower levels of plant water extracts.

Sno.	treatm. Datura: water (w/v)	statistical parameters	Mean germination*							Germ %age	Dead & black	Seedling survival %age
			Days after sowing (DAS)									
			3	5	7	8	10	12	15		seed %age	after 15 days
1.	T0 (control)	x	5	7.33	7.66	7.66	9	9.33	9.33	93.33	0.000	93.33
		SD	<u>+2</u> .16	±1.24	±0.93	±0.93	±0.81	±0.47	±0.47			
		Ser	±1.24	±0.71	±0.54	±0.54	±0.47	±0.27	±0.27			
2.	T1 (1:10)	X	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	23.33	0.00
		SD	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
		Ser	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
3.	T2 (1:20)	X	0.00	0.00	1.00	1.66	2.33	2.33	2.00	20.00	13.33	6.67
		SD	0.00	0.00	±0.81	±1.24	±1.699	±1.69	±1.63			
		Ser	0.00	0.00	±0.47	±0.71	±0.98	±0.98	±0.94			
4.	T3 (1:30)	X	0.00	1.33	3.00	3.333	4.333	4.333	4.33	43.33	10.00	33.33
		SD	0.00	±0.47	±2.44	±2.492	±1.699	±1.699	±1.69			
		Ser	0.00	0.27	±1.41	±1.438	±0.980	±0.980	±0.98			
5.	T4 (1:40)	X	0.666	5.333	6.00	6.00	8.00	8.00	8.33	83.33	0.00	83.33
		SD	±0.94	±0.47	0.00	0.00	±0.81	±0.81	±0.47			
		Ser	±0.54	±0.27	0.00	0.00	±0.41	±0.41	±0.27			

Table 1.1 depicting Mean values (\overline{X}), standard deviation (SD), and standard error (SER).



Figure 1.1 effect of *Datura stramonium* water extracts on wheat (GW273).

Conclusion

The allelopathic interactions showed that the weed *Datura stramonium* is dangerous and may cause great deal of lose to the economically important crop and its presence in the cultivating fields is a matter of concern. Despite of the stimulatory effects on root-shoot lengths the extracts inhibited germination process and the plant should be eradicated even if found near to the growing fields because the seeds contain the dangerous alkaloids and can be dispersed in the fields during seed dispersal. These seeds remain in dormant stage for years and when their dormant stage is over they grow vigorously and could make the precious fields toxic for the crop specie.

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