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EFFECT OF AQUEOUS EXTRACT OF *PARTHENIUM HYSTEROPHORUS* LINN. ON SEED GERMINATION AND RADICLE ELONGATION OF SOME CEREALS AND PULSES

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The wheat grains treated by aqueous extract of *Parthenium hysterophorus* showed decreased germination percentage. In inflorescence extract, the initiation period was extended to 120 h from 24 h and final germination percentage recorded was 15.6. In barley grains, the root and stem extract were more potent and there was only 5% germination at 20% concentration. In *Vigna radiata*, the root and inflorescence extracts were more potent as against stem and leaf extracts. In *Vigna mungo*, the root extract (20% concentration) extended the initiation period to 96 h. The rate of seed germination per 24 h was 1.7% and final germination percentage as 13%. Correlation coefficient (r) between extract concentrations and percentage germination and radicle elongation has also been worked out and nature was negative.

Keywords : Aqueous extract; Cereals and pulses; *Parthenium hysterophorus*; Radicle elongation; Seed germination.

Introduction

Parthenium hysterophorus is commonly known as carrot or congress weed of family Asteraceae. It is a wild, annual, much-branched erect herb with tap root stock. The stem is solid and striated with variable length of internodes. Leaves are pinnately dissected and flowers are arranged in terminal capitulum. It is commonly found as ruderals and has also invaded crop fields. The pollen grains are allergic and cause asthma[1]. The main chemicals in *Parthenium* are parthenin, p-coumaric acid, caffeic acid and sesquiterpene lactones. These inhibit the germination and growth of several crop plants[2-5]. In India, work is going on for replacement of this species by others[6,7]. In the light of above works, the present investigation was worked out to judge the competitive aggressiveness of *P. hysterophorus* over cereals and pulses in terms of germination and radicle length.

Material and Methods

The materials for present investigation are *Parthenium hysterophorous*, a congress weed and cereals like *Triticum aestivum* and *Hordeum vulgare* and pulses like *Vigna radiata* and *Vigna mungo*. Seeds of these species were collected locally and germinated on filter paper backed with cotton wool.

Roots, stems and leaves and inflorescence of *P. hysterophorus* were collected and chopped into small pieces. Ten percent aqueous extracts were prepared by crushing 10 gm leaves or stems or roots or inflorescence the case may be in a mixer with 100 ml distilled water. Extraction was done at room temperature by simple extraction method. From mother solution, desired concentrations 1, 5, 10 and 20% were prepared by dilution with distilled water. Now for germination and radicle growth, 25 seeds of species concerned were taken and surface sterilized by $HgCl_2$. Seeds were finally put in petridishes on filter paqper backed with cotton wool and were moistened with extracts of desired concentrations. The treatments were replicated thrice.

The petridishes were kept in diffuse light and at temperature 26±3°C. Daily readings were taken of germinating seeds. Period of initiation, rate of germination per 24 h and total percentage germination were recorded. Data were analysed by applying statistical methods[8]. The experiment was done in Deptt. of Botany, Patna Science College, Patna.

Results and Discussion

In wheat grains, the germination in control is 97%. The initiation period is 24 h and rate of seed germination per day is 14.3%. The grains treated by root, stem, leaf and inflorescence extract showed decreased germination percentage. The stem and leaf extract showed more or less similar effects. In leaf extract the initiation period increased from 24 h to 72 h as against inflorescence extract, where the period extended upto 120 h. The rate of

germination per 24 h was also drastically affected in inflorescence extract and at 20% extract, it was 2.8% only (Table 1). The radicle elongation was also affected. In control it was 10.5 cm while only 0.46 cm at 20% inflorescence extract.

In barley grains, the germination in control is 95%. The initiation period is 24 h and rate of seed germination / 24h is 14.3%. In response to each extract, the initiation period was affected and rate of seed germination per day also suffered. In stem extract, the initiation period was extended to 120 h and the rate of seed germination per 24 h is 1.1% (Table 2). The radicle elongation was also affected as in wheat. Inflorescence extract was more potent as against other extracts. At 20% inflorescence extract, the radicle length was 0.4 cm only.

In *Vigna radiata* the germination in control is 90.66%. The initiation period is 48 h and rate of seed germination per 24 h is 13.2%. The root and inflorescence extracts were more potent than stem and leaf extract. There was linear reduction in germination percentage from lower concentration to higher ones. In 20% inflorescence extract, the initiation period was 96 h, rate of seed germination/ 24h was 1.7% and final germination percentage was 13%. The radicle length in control is 4.2 cm. At 20% root and inflorescence extract, the radicle length was 0.7 cm and 0.5 cm, respectively (Table 3).

The germination percentage in *Vigna mungo* is similar as that of *Vigna radiata.* The initiation period and rate of seed germination per 24 h are also similar. Root extract treatment extended the initiation period to 96 h, the rate of seed germination/24 h to 1.7% and final germination percentage 13%. Similar was the result in inflorescence extract. The stem and leaf extract showed intermediate values.

In *Vigna mungo* the radicle length in control is 3.4 cm. It shows, maximum reduction in 20% inflorescence extract and length was 0.4 cm (Table 4).

Correlation co-efficient (r) between different concentrations and germination percentage and radicle elongation has been worked out. The nature of correlation was judged to be negative (Tables 5-6).

Thus, it is obvious that this weed has strong allelopathic potential against cereals and pulses. Aqueous inflorescence extracts were more potent as against root, stem and leaf extracts. The reduced germination percentage and radicle elongation were directly proportional to the increasing concentrations among the treatments. Twenty percent of the inflorescence extract had the strongest inhibitory effect.

Allelopathic effects of parthenin against two weedy species *Avena fatua* and *Bidens pilosa* have been worked out and reported that parthenin exerts an inhibitory effect on the growth and development of both weeds and can be further explored as an herbicide for future weed management strategies[9]. The inhibition in seed germination was due to allelochemicals, particularly phenolics[10-12] and other secondary metabolites like growth regulators, alkaloids[13], terpenoids[14,15] and toxins which are present in various plant parts and are released into the environment through volatilization, leaching, root exudation and decomposition of plant residues. Inhibitory effects of weed extracts have been advocated due to presence of phenolics, caffeic, gallic, protocatechuic and ferulic acids[16]. Allelopathic effects of seven weed extracts on seed germination in different varieties of wheat were investigated[4]. There was 90% reduction with *P. hysterophorus* in seed germination in each variety. Three phenolic acids in crushed plant materials of *P. hysterophorus* were also identified.

Parthenium is one of the best known plant invaders in the world linking allelopathy to exotic invasion[17,18]. Lack of co-evolved tolerance of resident vegetation to new chemicals produced by the invader could allow these newly arrived species to dominate natural plant communities[19]. *P. hysterophorus* has the potentials to disrupt natural ecosystem by allelopathic effect, which may be an important mechanism involved in invasive success of this plant[20,21].

There are reports that allelochemicals inhibit respiration[11] and energy transfer[22] responsible for ATP synthesis. The harmful effect of higher extract concentration on growth parameters might be due to excess of allelo-chemicals which inhibit Gibberellin and IAA induced growth[5]. Field experiments are necessary before any final conclusions are made on allelopathic effects of weed species[23].

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Table 1. Effect of *Parthenium* extracts on different parameters of *Triticum aestivum.*

Concentrations (%)	Root extract				Stem extract				Leaf extract				Inflorescence extract			
	Initiation period in hour	Rate of seed germination/24 h (in %)	% seed germination	Mean length of radicle in cm	Initiation period in hour	Rate of seed germination/24 h (in %)	% seed germination	Mean length of radicle in cm	Initiation period in hour	Rate of seed germination/24 h (in %)	% seed germination	Mean length of radicle in cm	Initiation period in hour	Rate of seed germination/24 h (in %)	% seed germination	Mean length of radicle in cm
Control	24	14.3	97.3 ± 1.44	10.5 ±0.35	24	14.3	97.33 ± 1.44	10.5 ±0.35	24	14.3	97.3 ±1.44	10.5 ±.35	24	14.3	97.33 ±1.44	10.5 ±0.35
1	24	13.1	93.33 ± 2.51	4.9 ± 0.42	24	10.2	68.33 ± 2.02	5.4 ± 0.24	24	11.4	75 ±2.88	7.5 ±0.65	24	12.5	75 ±2.88	4.6 ±0.21
5	24	9.1	62.66 ± 2.51	3.6 ± 0.26	24	9.1	60.33 ± 2.02	4.5 ± 0.16	24	9.1	60.33 ±2.02	7.2 ±0.19	24	9.1	60.33 ±2.02	2.5 ±0.20
10	24	6.85	44.33 ± 2.33	3.4 ± 0.16	24	7.4	49 ± 2.07	4.2 ± 0.20	48	5.7	44.33 ±2.33	5 ±0.16	48	4.5	29 ±2.07	1.3 ±0.33
20	24	4	23.66 ± 2.33	3.2 ± 2.09	24	4.5	29 ± 2.07	3.3 ± 0.10	72	4.5	29 ±2.07	3.7 ± 0.20	120	2.8	15.6 ±2.33	0.46 ±0.14

Table 2. Effect of *Parthenium* extracts on different parameters of *Hordeum vulgare.*

Concentrations (%)	Root extract				Stem extract				Leaf extract				Inflorescence extract			
	Initiation period in hour	Rate of seed germination/24 h (in %)	% seed germination	Mean length of radicle in cm	Initiation period in hour	Rate of seed germination/24 h (in %)	% seed germination	Mean length of radicle in cm	Initiation period in hour	Rate of seed germination/24 h (in %)	% seed germination	Mean length of radicle in cm	Initiation period in hour	Rate of seed germination/24 h (in %)	% seed germination	Mean length of radicle in cm
Control	24	14.3	95 ±2.88	11.5 ±0.35	24	14.3	95 ±2.88	11.5 ±0.35	24	14.3	95 ±2.88	11.5 ±0.35	24	14.3	95 ±2.88	11.5 ±0.35
1	48	8.0	52.66 ±1.76	5.4 ±0.28	48	8	52.66 ±1.76	5.7 ±0.25	48	11.4	75 ±2.88	8.7 ± 0.20	48	12	75 ±2.88	4.9 ±0.19
5	48	5.1	29 ±2.09	4.1 ±0.40	48	4.6	29 ±2.07	4.5 ±0.22	48	8.5	62.66 ±2.51	7.6 ±0.25	48	8.5	62.66 ±2.51	2.9 ±0.25
10	96	2.2	15 ±0.57	2.8 ±0.13	96	2.3	15 ±0.57	4.2 ±0.085	96	3.4	15.6 ±2.33	5.4 ±0.28	48	2.3	15 ±0.57	0.52 ±0.11
20	96	0.57	5.33 ±0.88	1.5 ±0.18	120	1.1	5.33 ±0.88	3.5 ±0.18	96	2.3	15 ±0.57	4.5 ±0.48	96	1.7	13 ±0.57	0.4 ±0.063

Table 3. Effect of *Parthenium* extracts on different parameters of *Vigna radiata.*

Concentrations (%)	Root extract				Stem extract				Leaf extract				Inflorescence extract			
	Initiation period in hour	Rate of seed germination/24 h (in %)	% seed germination	Mean length of radicle in cm	Initiation period in hour	Rate of seed germination/24 h (in %)	% seed germination	Mean length of radicle in cm	Initiation period in hour	Rate of seed germination/24 h (in %)	% seed germination	Mean length of radicle in cm	Initiation period in hour	Rate of seed germination/24 h (in %)	% seed germination	Mean length of radicle in cm
Control	48	13.2	90.66 ±1.20	4.2 ±0.092	48	13.2	90.66 ±1.20	4.2 ±0.092	48	13.2	90.66 ±1.20	4.2 ±0.092	48	13.2	90.66 ±1.20	4.2 ±0.092
1	48	10.3	68.33 ±2.02	2.9 ±0.12	48	10.3	75 ±2.88	2.8 ±1.02	48	11.4	75 ±2.88	4.1 ±0.096	48	9.7	60.33 ±2.02	3.3 ±0.12
5	48	8.5	62.66 ±2.51	2.5 ±0.17	48	11.4	68.33 ±2.02	2.4 ±0.15	48	10.3	68.33 ±2.02	2.7 ±0.13	48	6.3	44.33 ±2.33	1.7 ±0.11
10	48	6.9	44.33 ±2.33	1.9 ±0.25	48	8.5	44.33 ±2.33	1.5 ±0.12	48	9.7	60.33 ±2.02	1.3 ±0.13	72	2.3	15 ±0.57	1.5 ±0.16
20	72	2.8	15.66 ±2.33	0.7 ±0.12	72	2.8	15.66 ±2.33	1.2 ±0.085	72	4	29 ±2.07	0.62 ±0.066	96	1.7	13 ±0.57	0.5 ±0.11

Table 4. Effect of *Parthenium* extracts on different parameters of *Vigna mungo.*

Concentrations (%)	Root extract				Stem extract				Leaf extract				Inflorescence extract			
	Initiation period in hour	Rate of seed germination/24 h (in %)	% seed germination	Mean length of radicle in cm	Initiation period in hour	Rate of seed germination/24 h (in %)	% seed germination	Mean length of radicle in cm	Initiation period in hour	Rate of seed germination/24 h (in %)	% seed germination	Mean length of radicle in cm	Initiation period in hour	Rate of seed germination/24 h (in %)	% seed germination	Mean length of radicle in cm
Control	48	13.2	90.66 ±1.20	3.4±0.15	48	13.2	90.66 ±1.20	3.4 ±0.15	48	13.2	90.66 ±1.20	3.4 ±0.15	48	13.2	90.66 ±1.20	3.4 ±0.15
1	48	9.1	62.66 ±2.51	2.7 ±0.13	48	8.5	62.66 ±2.51	2.4 ±0.14	48	10.2	68.33 ±2.02	3.4 ±0.15	48	9.7	60.33 ±2.02	3.3 ±0.16
5	48	4.5	29±2.07	2.4±0.17	48	5.7	60.33 ±2.02	2.2±0.085	48	6.8	44.33 ±2.33	1.8 ±0.12	48	6.3	44.33 ±2.33	1.4 ±0.083
10	72	2.2	15 ±0.57	2.1±0.15	72	3.1	15.6 ±2.33	1.5±0.11	72	10.2	60.33 ±2.02	1.4 ±0.10	72	2.3	15 ±0.57	1.2 ±0.092
20	96	1.7	13 ±0.57	1.3±0.12	96	2.2	15 ±0.57	1.2 ±0.085	120	2.2	15 ±0.57	0.54 ±0.12	96	1.7	13 ±0.57	0.40 ±0.070

Table 5. Correlation between *Parthenium* concentrations and germination percentage.

S. No.	Concentration and germination percentage	Value of correlation coefficient (r)	Nature of correlation
1.	Root extract of *Parthenium* on wheat grain	0.955*	- ve
2.	Stem extract of *Parthenium* on wheat grain	0.999***	- ve
3.	Leaf extract of *Parthenium* on wheat grain	0.9293*	- ve
4.	Inflorescence extract of *Parthenium* on wheat grain	0.931*	- ve
5.	Root extract of *Parthenium* on barley grain	0.9452*	- ve
6.	Stem extract of *Parthenium* on barley grain	0.9058*	- ve
7.	Leaf extract of *Parthenium* on barley grain	0.915*	- ve
8.	Inflorescence extract of *Parthenium* on barley grain	0.893*	- ve
9.	Root extract of *Parthenium* on moong	0.999***	- ve
10.	Stem extract of *Parthenium* on moong	0.9395*	- ve
11.	Leaf extract of *Parthenium* on moong	0.966***	- ve
12.	Inflorescence extract of *Parthenium* on moong	0.8847*	- ve
13.	Root extract of *Parthenium* on urad	0.8455*	- ve
14.	Stem extract of *Parthenium* on urad	0.92015*	- ve
15.	Leaf extract of *Parthenium* on urad	0.9182*	- ve
16.	Inflorescence extract of *Parthenium* on urad	0.8867*	- ve

*Significant at P = 0.05 ***Significant at P = 0.01

Table 6. Correlation between *Parthenium* concentrations and radicle length.

S.No.	Concentration and radicle length	Value of correlation coefficient (r)	Nature of correlation
1.	Root extract of *Parthenium* on wheat grain	0.793	- ve
2.	Stem extract of *Parthenium* on wheat grain	0.840*	- ve
3.	Leaf extract of *Parthenium* on wheat grain	0.964***	- ve
4.	Inflorescence extract of *Parthenium* on wheat grain	0.919*	- ve
5.	Root extract of *Parthenium* on barley grain	0.975***	- ve
6.	Stem extract of *Parthenium* on barley grain	0.924*	- ve
7.	Leaf extract of *Parthenium* on barley grain	0.981*	- ve
8.	Inflorescence extract of *Parthenium* on barley grain	0.865*	- ve
9.	Root extract of *Parthenium* on moong	0.999***	- ve
10.	Stem extract of *Parthenium* on moong	0.937*	- ve
11.	Leaf extract of *Parthenium* on moong	0.934***	- ve
12.	Inflorescence extract of *Parthenium* on moong	0.918*	- ve
13.	Root extract of *Parthenium* on urad	0.998***	- ve
14.	Stem extract of *Parthenium* on urad	0.951*	- ve
15.	Leaf extract of *Parthenium* on urad	0.921*	- ve
16.	Inflorescence extract of *Parthenium* on urad	0.872*	- ve

*Significant at P = 0.05 ***Significant at P = 0.01

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