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Ash of *Parthenium Hysterophorus* L. is Harmful for Seed Germination and Growth of Seedlings of *Cajanus cajan* L.

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Abstract
In laboratory condition phytotoxicity levels of ash of whole plant of *Parthenium hysterophorus* on the rate of seed germination, length of root and shoot and Seed Vigour Index (SVI) of *Cajanus cajan* was evaluated. The different concentrations of ash of *Parthenium* in the experiment were 1%, 5%, 10%, 15% and 20%. A control condition was maintained also. Ten seeds of *C.cajan* were placed in each petridishes with ten replicates. The percent decrease in seed germination, relation elongation ratio of root and shoot in different concentrations, respectively, ranged from 3.57% to 94.64%; 0.10% to 48.74% and 0.41% to 61.11%. The percent decrease in root length and shoot length values ranged from 51.26% to 99.90% and 38.89% to 99.59%, respectively. The fresh and dry weight of root and shoot values decreased by 10 to 100%; 14.29 to 100%; 47.27 to 98.18%; and 55.56 to 100%, respectively. The root:shoot ratio value decreased by 20.15 to 79.85% whereas the SVI value decreased by 47.90% to 99.99%. The present study indicated that with increase in concentration of ash the rate of seed germination and growth of seedlings decreased. Thus burning of *Parthenium* in agricultural fields by harmful for crops.

Keywords: Ash, *Parthenium hysterophorus*, *Cajanus cajan*, Phytotoxicity, Seed germination

1. Introduction

Parthenium hysterophorus L. is an annual aggressive colonizer; shows allelopathic effects; induces changes in the physical, chemical and biological properties of soil; replaces palatable grasses (Pandey et al. 2003; Tiwari et al. 2005; Batish et al. 2002; Bhowmik et al. 2007). This weed has spread in all states of India and has achived major status in India and other countries of the world (Kaushik et al. 2005; Dwivedi et al. 2009). The presence of *Parthenium* has the drastic effect on the agricultural crops and also causes health hazards in human beings; and effects ecosystem and biodiversity (Adkins and sowbery 1996; Kumari et al 2014). The allelochemicals are present in all parts of *Parthenium*.

Parthenin is the major llelochemicals causing allelopathy. The rapid expansion and widespread distribution of *Parthenium* has become a challenging threat to the productivity and sustainability of the agroecosystems. This weed has become one of the seven most dangerous weed of the world (Kumar 2015). It has invaded more than 34 countries around the globe (Adkins and Shabbir 2014). It causes severe economic losses. McConnachie et al. (2011); Mainali et al. (2015) and kriticos et al. (2015) through climatic modelling studies have reported that the invasive range of *Parthenium* may expand considerably further. In 2012 it coveed around 35 million ha of wasteland, crop land and forest land in India (Kumar 2012).

Parthenium hysterophorus L. starts its growth before the rainy season and covers whole area of the University campus of J.P.University Chapra and the adjacent agricultural fields which suppresses the growth of other herbaceous vegetation and crops. It remains covered with its peak growth in agricultural lands. Farmers through ploughing in agricultural field uproot *Parthenium* or harvest, collect and burn in the agricultural fields. Literature on effects of *Parthenium* ash on seed germination and growth of crops are only a few.

Cajanus cajan an important pulse of the region is grown by farmers on large scale. The large

amount of burnt ash of *Parthenium* remains with *Cajanus cajan* sown or other crops sown by farmers in the agricultural fields.

2. Materials and methods

Parthenium plants were uprooted from the University campus of J.P.University Chapra during their peak growth period in 2017. They were collected and stored adjacent to the Department of Botany and air-dried in open place. After drying of the plants collected, they were burnt and ashes were collected to conduct the experiments.

Ash aqueous extract of *Parthenium* was prepared and following treatments were done in this experiment:

Control condition i.e. without addition of extract of ash, 1% ash extract, 5% ash extract, 10% ash extract, 15% ash extract, and 20% ash extract. For each treatment ten replicates were maintained. Ten seeds in each petridish covered with whatman's filter paper were placed and watered regularly when required.

After seven days of setting up of the experiment following data were collected for each treatment:

Rate of seed germination, Root length, Shoot length, Fresh weight of root, Dry weight of root, Fresh weight of shoot, Dry weight of shoot, Root:Shoot ratio, Seed Vigour Index (SVI), Relation elongation ratio of root, Relation elongation ratio of shoot, and Inhibition in seed germination

Further per cent increase or decrease in root length, shoot length, fresh weight of root, dry weight of root, fresh weight of shoot, dry weight of shoot, Root: Shoot ratios and SVI were calculated for 1%, 5%, 10%, 15% and 20 % of ash treatments compared to control condition.

3. Results & Discussion

Data obtained in experiment done in laboratory condition are in Tables 1, 2 and 3 and Fig. 1.

3.1 Seed Germination (%): The rate of seed germination in control condition in *C.cajan* was 93.33% whereas these values in 1%, 5%, 10%, 15% and 20% ash extract of *Parthenium* were 90, 90, 66.67, 48.33 and 5.0%, respectively (Table 9.6). The inhibition rate in seed germination ranged from 3.57% in 1% and 5 % treatments to 94.67% in 20% treatment (Table 9.7). Thus the maximum rate of inhibition in seed germination was 94.67% in 20% ash extract; and higher concentrations of ash extract were inhibitorier than the lower concentrations of ash extract.

3.2 Root Length (cm): The root length values in control condition were 9.91cm whereas these values ranged from 0.01cm to 4.83cm in different treatments (Table 9.6). The root length values decreased with increase in the concentrations of ash extract. The per cent decrease in root length values were 51.26, 61.76, 93.14, 96.37 and 99.90%, respectively, in 1%, 5%, 10%, 15% and 20% treatments compared to control condition (Table 9.8).

3.3 Shoot Length (cm): The shoot length value in control condition was 7.38cm whereas these values ranged from 0.03cm in 20% treatment to 4.51cm in 1% treatment (Table 9.6). The shoot length values also decreased with the increase in concentrations of ash extract. In comparison to control condition the per cent decrease in shoot length values 1%, 5%, 10%, 15% and 20% treatments were 38.89%, 48.37%, 71.82%, 81.84% and 99.59%, respectively (Table 9.8).

3.4 Fresh Weight of Root (g): In control condition the fresh weight of root was recorded 0.20g whereas in different treatments these values ranged from 0.00g in 20% treatment to 0.38g in 15% treatment (Table 9.6). In 1% treatment the fresh weight of root increased by 30% and in 15% it increased by 90% compared to control condition. In 5%, 10% and 20% treatments these values decreased by 10, 50 and 100% compared with control condition (Table 9.8).

3.5 Dry Weight of Root (g): In control condition and in 1% treatment the dry weight value of root was 0.07g whereas in other treatments these values ranged from 0.00g in 20% treatment to 0.09g in 5% treatment (Table 9.6). No difference in dry weight value was observed in 1% treatment compared to control condition whereas in 5% treatment this value increased by 28.57%. In 10%, 15% and 20% treatments these values decreased by 14.29%, 71.43% and 100% respectively compared to control condition (Table 9.8).

3.6 Fresh Weight of Shoot (g): It was recorded 0.55g in control condition whereas the values for different treatments ranged from 0.01g in 20% treatment to 0.29g in 1% treatment (Table 9.6). With increase in the concentrations of ash extract the fresh weight of shoot decreased. In 1%, 5%, 10%, 15% and 20% treatments the per cent decrease in fresh weight of shoot values were 47.27%, 60%, 85.45%, 87.27% and 98.18%, respectively compared to control condition (Table 9.8).

3.7 Dry Weight of Shoot (g): For control condition this value was recorded 0.18g whereas these values for other treatments ranged from 0.00g for 20% treatment to 0.08g for 1% treatment (Table 9.6). With comparison to control treatment the per cent decrease in dry weight of shoot values in 1%, 5%, 10%, 15% and 20% treatments were 55.56, 66.67, 77.78, 77.78 and 100%, respectively (Table 9.8). With increase in the concentrations of the dry weight of shoot decreased. Maximum decrease was observed in 20% treatment and minimum in 1% treatment.

3.8 Root: Shoot Ratio: For control treatment this value was 1.34 whereas in different treatments these values ranged from 0.27 for 10% treatment to 1.07 for 1% treatment (Table 9.6). The values for per cent decrease in root: shoot in 1%, 5%, 10%, 15% and 20% treatments were 20.15, 26.12, 75.37, 79.85 and 75.37%, respectively compared to control condition (Table 9.8).

3.9 Seed Vigour Index (SVI): For control treatment the SVI value was recorded 1613.68 whereas for other treatments these values were 840.6, 684, 184.01, 82.16 and 0.2, respectively, in 1, 5, 10, 15 and 20% treatments (Table 9.6). The per cent decrease in SVI values compared to control condition in 1%, 5%, 10%, 15% and 20% treatments were recorded as 47.90, 57.61, 88.60, 94.90 and 99.99%, respectively (Table 9.8). This indicated that with increase in the concentration of ash the Seed Vigour Index values decreased.

3.10 Relation Elongation Ratio of Root (%): In relation to control condition the relation elongation ratio of root in 1, 5, 10, 15 and 20% treatments the values were recorded as 48.74, 38.24, 6.86, 3.63 and 0.10%, respectively (Table 9.7). With increase in the concentrations of ash the per cent decrease in root elongation ratio values were 51.26, 61.76, 93.14, 96.37 and 99.90% respectively, in 1, 5, 10, 15 and 20% treatment, respectively.

3.11 Relation Elongation Ratio of Shoot (%): These values in 1, 5, 10, 15 and 20% treatments were 61.11, 51.63, 28.18, 18.16 and 0.41% respectively (Table 9.7). With comparison to control treatment the per cent decrease in these values were 38.89, 48.37, 71.82, 81.84 and 99.59% in 1, 5, 10, 15 and 20% treatments, respectively. Thus with increase in ash concentrations the shoot length value decreased.

Kumar et al. (2010) have evaluated the effect of ash of *P.hysterophorus* on seed germination and seedling growth of *Phaseolus mungo* both in laboratory and field conditions by using 1, 3, 5 and 7% ash concentrations. In laboratory condition seed germination rate was 100% in 1% and 3% ash concentrations and seedling growth was highest in control condition followed by 1% and 3%. Onward 3% no germination, plumule and radicle length were reported.

They have reported that the ash content of *Parthenium* has negative effect on the growth of *P. mungo* and suggested that after ploughing *Parthenium* should not be burned in the agricultural fields. Kumar and Kumar (2010) have reported that even moisture content in root and shoot in *P.mungo* treated with differrent concentrations of ash also reduced compared to control condition.

The experiments conducted in laboratory conditions in 1% ash concentrations of *Parthenium* decreased the rate of seed germination (3.57%), relation elongation ratio of root and shoot (51.26 and 38.89%), root length (51.26%), shoot length (38.89%), fresh weight of shoot (47.27%), dry weight of shoot (55.56%), root:shoot (20.15%) and SVI (47.90%) compared to control condition. Only fresh weight of root increased by (30%)

5% treatment ash decreased the rate of seed germination (3.57%), relation elongation ratio of root and shoot (61.76 and 48.37%), root length (61.76%), shoot length (48.37), fresh weight of root (10%), fresh weight of shoot (60%), dry weight of shoot (66.67%), root: shoot ratio (26.12%) and SVI (57.61%) compared to control condition.

In 10% concentration of ash treatment the rate of seed germination (28.57%), relation elongation ratio of root and shoot (93.14 and 71.8 %), root length (93.14%), shoot length (71.82%), fresh weight of root (50%), dry weight of root (14.29%), fresh weight of shoot (85.45%), dry weight of shoot (77.78%), root: shoot ratio (75.37%), and SVI (88.60 %) decreased compared to control condition.

The 15% concentration of ash treatment decreased the rate of seed germination (48.21 %), relation elongation ratio of root and shoot (96.37 and 81.84%), root length (96.37%), shoot length (81.84%), dry weight of root (71.43%), fresh weight of shoot (87.27%), dry weight of shoot (77.78%), root: shoot ratio (79.85%) and SVI value (94.90%) compared to control condition.

The 20% concentration of ash treatment decreased the rate of seed germination (94.64%), relation elongation ratio of root and shoot (99.90% and 99.95%), root length (99.90%), shoot length (99.59%), fresh and dry weight of root (100%), fresh weight of shoot (98.18%), dry weight of shoot (100%), root: shoot ratio (75.37%) and SVI value (99.99%) compared to control condition.

Water soluble phenolics and sesquiterpene lactones, parthenin, caffic acid, P-coumaric acid, ferulic acid, vanicillic acid, anisic acid, fumaric acid etc have been reported from roots, stem, eaves, inflorescence, pollens, seeds and even from air–dried root and leaf materials. Thus, it is evident that with increase in the concentration of ash in laboratory condition the rate of seed germination and other growth parameters studied decreased compared to the control condition.

Table: 1: Rate of seed germination and growth parameters in different treatments in laboratory condition.

Sl. N	Treatment (%)	Germination (%)	Root Length (cm)	Shoot Length (cm)	Fresh wt. of Root (g)	Dry wt. of Root (g)	Fresh wt. of Stem (g)	Dry wt. of Stem (g)	R/S Ratio	SVI
1	Control	93.33	9.91 ±1.2	7.38 ±1.05	0.20	0.07	0.55	0.18	1.34	1613.68
2	1%	90	4.83 ±0.93	4.51 ±0.86	0.26	0.07	0.29	0.08	1.07	840.6
3	5%	90	3.79 ±0.83	3.81 ±0.75	0.18	0.09	0.22	0.06	0.99	684
4	10%	66.67	0.68 ±0.32	2.08 ±0.62	0.10	0.06	0.08	0.04	0.33	184.01
5	15%	48.33	0.36 ±0.20	1.34 ±0.52	0.38	0.02	0.07	0.04	0.27	82.16
6	20%	5.0	0.01 ±0	0.03 ±0	0.00	0.00	0.01	0.00	0.33	0.2

Table: 2: Per cent stimulation (+) or inhibition (-) in seed germination rate and root and shoot relation elongation ratio in different treatments in laboratory condition.

Sl. N	Treatment (%)	Inhibition (-) or Stimulation (+) %	Relation Elongation ratio of Root (%)	Relation Elongation ratio of Shoot (%)
1	1%	-3.57	48.74	61.11
2	5%	-3.57	38.24	51.63
3	10%	-28.57	6.86	28.18
4	15%	-48.21	3.63	18.16
5	20%	-94.64	0.10	0.41

Table: 3: Per cent increase (+) or decrease (-) in growth parameters in laboratory condition in different treatments.

Sl no.	Treatment (%)	% + or - RL	% + or - SL	% + or – FWR	% + or - DWR	% + or - FWS	% + or – DWS	% + or – R: S Ratio	% + or - SVI
1	1	-51.26	-38.89	+30.0	0.00	-47.27	-55.56	-20.15	-47.90
2	5	-61.76	-48.37	-10.0	+28.57	-60.0	-66.67	-26.12	-57.61
3	10	-93.14	-71.82	-50.0	-14.29	-85.45	-77.78	-75.37	-88.60
4	15	-96.37	-81.84	+90.0	-71.43	-87.27	-77.78	-79.85	-94.90
5	20	-99.90	-99.59	-100.0	-100.0	-98.18	-100.0	-75.37	-99.99

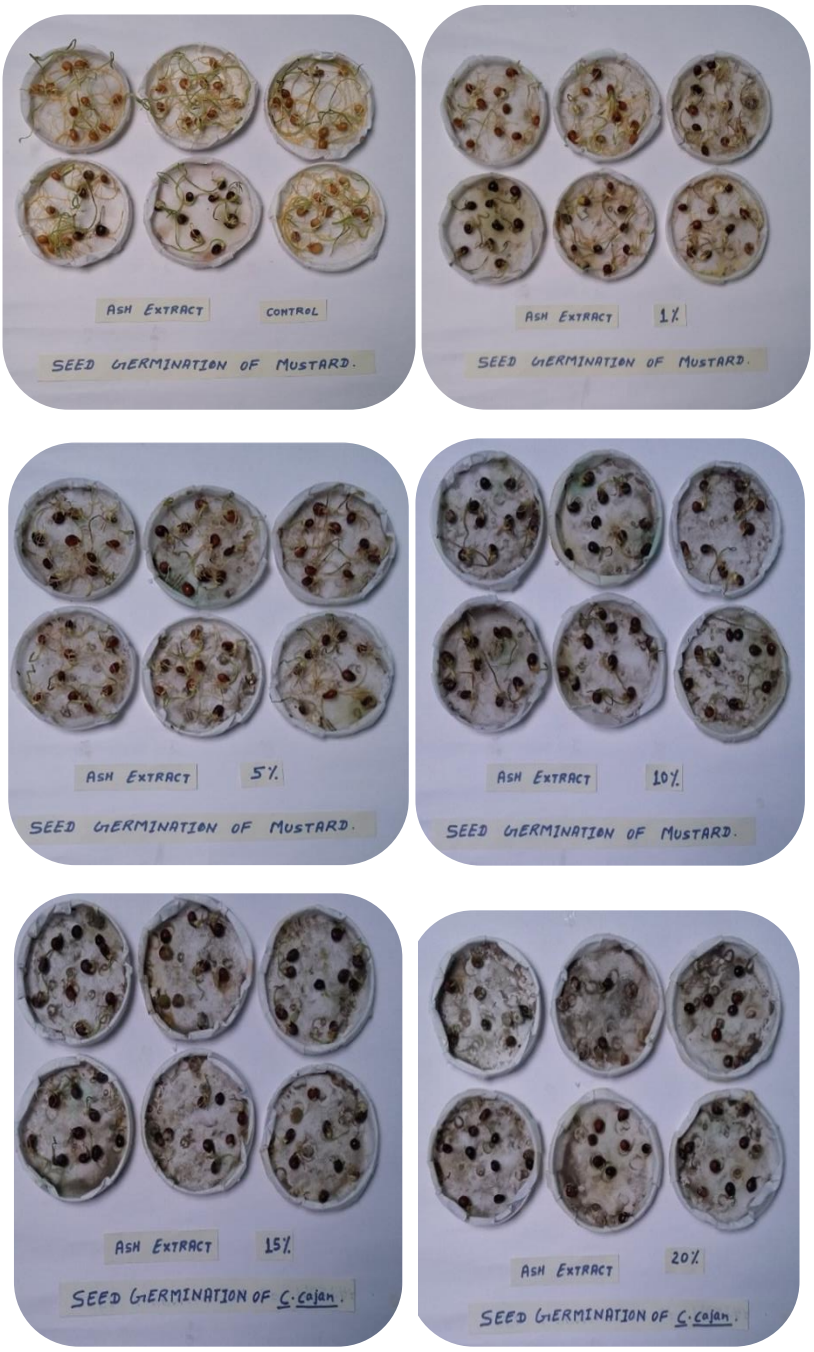

Fig 1: Growth of *C.cajan* in different concentrations of ash of *Parthenium*.

Conclusions

The present study indicated that ash of *Parthenium* is harmful for the germination and growth of *Cajanus cajan*. Thus burning of *Parthenium* in cropland should not be done.

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