Allelopathic potential of *Parthenium hysterophorus* L. on pollen germination and pollen tube growth of *Phaseolus mungo* cv.T-9 and *Zea mays* L.cv. GANGA SAFED-2

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SUMMARY

***Parthenium hyterophorus* L. was evaluated for its pollen allelopathy. Leachate obtained from the pollen grains of *Parthenium* caused significant inhibition in pollen germination *i.e.* 32.53% in *Phaseolus mungo* and 30.19% in *Zea mays*. Inhibition in pollen tube growth was 54.72% in *Phaseolus mungo* and 40.29% in *Zea mays*. Treatment with higher concentration exerted more inhibition in these parameters. Moreover, inhibition in pollen germination and pollen tube growth was found more in *Phaseolus mungo* than in *Zea mays*. Some pollen tubes of *Phaseolus* were found to be thin and some were distorted.**

Key words : *Parthenium*, allelopathy, *Phaseolus mungo*, *Zea mays*, Pollen grains and leachate

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Allelopathy refers to the beneficial or harmful effect of one plant to another plant by the release of chemicals from different plant parts by leaching, root exudation, volatilization, residue decomposition and other processes. Common effects of allelopathy include reduced seed germination and seedling growth. However, known sites of action for some allelochemicals include cell division, pollen germination, nutrient uptake, photosynthesis and specific enzyme function. Allelopathic effect of one pollen grain to pollen germination, pollen tube growth (Murphy and Aarssen, 1995,a,b,c) and seed set of another plant is called pollen allelopathy. *Parthenium hysterophorus* L. also known as 'carrot weed' , 'congress grass',' white head', 'gajarghass', is a herbaceous, erect and annual plant belonging to the family Asteraceae. *P. hysterophorus* L. has been reported to contain several allelochemicals, like parthenin, kermpferol, p-cumaric acid, caffeic acid etc. (Pickman and Towers, 1982). Organic compounds like phenolic acids and flavonoids have been found to retard the growth of several plants (Mall and Dagar, 1979). *Parthenium* is not only harmful to crops but also causes several diseases to man e.g. asthma, contact dermatitis and loss of weight, eye irritation in dogs and horses (Towers *et al.*, 1977).

Phaseolus mungo cv.T-9 (black gram or urd or mash) a leguminous crop, is highly priced pulse. It is early maturing (80 days), erect, medium, black seeded recommended as a early crop in *kharif*.

Maize (*Zea mays* L. var. Ganga safed–2), a cereal crop belonging to the family Graminae, is high yield hybrid variety. There are no report on all epathic effect of pollen grain of *Parthenium hysterophorus* L. on pollen germination and pollened tube growth of these two plants.

MATERIALS AND METHODS

Pollen grains of *P.hysterophorus* were collected at random from the field. One gram of pollen grains were mixed in 10ml of double distilled water in Erlenmeyer flask under aseptic condition and kept for three days at 8°C in referigerater. Aqueous leachate was filtered through Whatman no.1 filter paper. Aqueous leachate so obtained was taken as 100% concentration leachate. To prepare 50% concentration leachate sterilized distilled water was added in the ratio of 1:1. Leachates were used to prepare nutrient medium for pollen germination. For control, pollen grains were germinated on nutrient medium without leachates.

Brewbaker and Kwack (1963) and Roberts *et al*. (1983) media were used for pollen germination and pollen tube growth for black gram and maize, respectively. Percentage of pollen germination and pollen tube growth were studied by the method given by Iwanami (1959). Semisolid media were prepared by adding 1% agar to the liquid media and were heated to dissolve the latter and poured on the slides. On cooling, thin agar-

nutrient plates were formed. Pollen grains of black gram and maize were spread separately on cover glasses as evenly as possible scraped with the edge of another cover glass pollen spread out and touched it on the medium. The pollen grains thus placed on the medium were in perfect straight row. Data were recorded at 12 and 24 hrs. Experiment was laid out with five replicates and repeated twice. Composition of nutrient media is given below.

Table 1 : Composition of nutrient media for *in vitro* germination of pollen grains

Constituents	Brewbaker and Kwack (1963) medium amount (mg/l)	Roberts *et al.* (1983) medium amount (mg/l)
Sucrose	100,000	200,000
H_3BO_3	100	10
$Ca(NO_3)_2.H_2O$	300	----
$CaCl2.6H_2O$	----	362
$MgSO_4.7H_2O$	200	----
KNO_3	----	100
pH	7.3	8

Statistical analysis:

Statistical analysis of date was done wherever necessary. Mean, standard error (SE) and analysis of variance (ANOVA) were calculated according to Sndecor and Cochran (1967).

RESULTS AND DISCUSSION

Allelopathic effect of pollen grains of Parthenium hysterophorus L. on pollen germinataion of pollen tube growth of Phaseolus mungo var.T-9:

In *Phaseolus mungo* **,**the percentage of pollen germination and pollen tube growth at 12 and 24 hours of control were 31.18±0.23%, 10.26±0.18x, 89.28±0.17 and 22.13±0.27x, respectively (Table 2). Pollen grains on the nutrient medium of 100% leachate concentration with the corresponding values of 15.01±0.36%, 7.01±0.14x, 60.23±0.75%, 10.02±0.16x exhibited marked variation over the control followed by pollen grains on the medium with 50% leachate concentration (Table 2). Per cent inhibition of pollen germination and pollen tube growth over the control at 24 hours of 50% and 100% concentration leachates were 21.46, 17.62%, 32.53% and 54.42%, respectively (Fig. 1).

Allelopathic effect of pollen grains of Parthenium hysterophorus L. on pollen germination and pollen tube growth of Zea mays var. Ganga Safed -2:

Pollen germination and pollen tube growth on the nutrient medium of 100% leachate concentration at 12 and 24 hours with the corresponding values of 8.03±0.02%, 6.01±0.13x, 57.26±0.49%, 12.09±0.34x exhibited marked variation over control followed by pollen grains on the medium with 50% leachate concentration (Table 3). Per cent inhibition of pollen germination and pollen tube growth over control at 24 hours of 50% and 100% concentration leachates were 19.45%, 14.91%, 30.9% and 40.29% respectively, (Fig. 2).

It was observed that in the presence of pollen grains leachate of *Parthenium*, pollen germination and pollen tube growth of *Phaseolus mungo* and *Zea mays* were reduced. Reduction was more in presence of 100% concentration leachate than 50%. Some pollen tubes of *Phaseolus mungo* were thin and distorted in 100% leachate

Pollen grains are activated before germination. During activation pollen grains cistarnal or RER arranged in stacks in mature are set free. There is production of abundant vesicles (small ones are concerned with the formation of pectocellulosic wall and large ones are concerned with the formation of callosic wall layer. Aggregation of ribosomes into polysomes and formation of lamellae inside the plastids are seen. Activation of pollen grains does not induce any change in mitochondria, generative cell and vegetative nucleus (Cristae *et al.*, 1977). RNAs are transcribed before the morphological ripening of pollen and stored in an inactive form. As a result, the pollen can germinate and the tube can grow to a certain length when incubated in the presence of a transcription inhibitor such as Actinomycin-D. The pollen tube as a rule, emerge at the germ pore on the pollen

Table 2 : Allelopathic effect of pollen grain leachate of *Parthenium hysterophorus* L.on pollen germination and pollen tube growth of *Phaseolus mungo* var. T-9

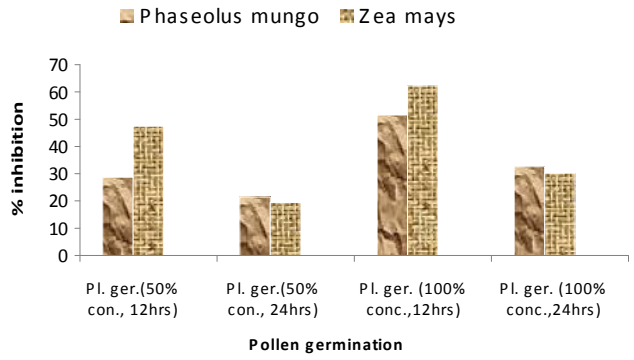
Pollen leachate	12 hours		24 hours	
	Germination (%)	Length of pollen tube (×)	Germination (%)	Length of pollen tube(×)
100%	15.01±0.36 (51.57%)	7.01±0.14 (31.67%)	60.23±0.75 (32.53%)	10.02±0.16 (54.72%)
50%	22.23±1.23 (28.70%)	8.03±0.17 (21.73%)	70.12±0.29 (21.46%)	18.23±0.29 (17.62%)
Control	31.18±0.23	10.26±0.18	89.28±0.17	22.13±0.27

Values in parentheses are per cent inhibition over the control. Length of pollen tubes were estimated in numbers of pollen grain diameters. Significant to't' test, mean ± t (0.05)×SEM, DF=4.0

Table 3 : Allelopathic effect of pollen grain leachate of *Parthenium hysterophorus* L.on pollen germination and pollen tube growth *Zea mays* var. Ganga Safed-2

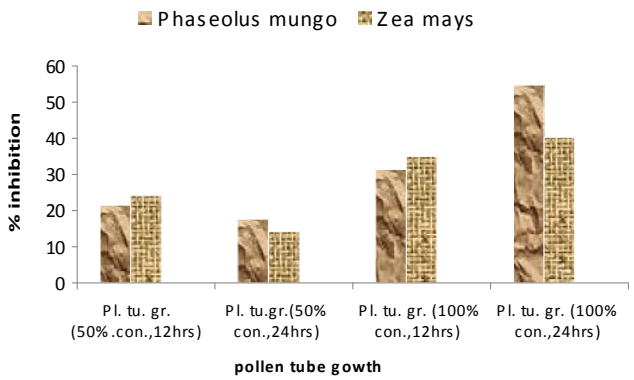
Pollen leachate	12 hours		24 hours	
	Germination (%)	Length of pollen tube (×)	Germination (%)	Length of pollen tube(×)
100%	8.03±0.26 (62.22%)	6.01±0.13 (35.02%)	57.26±0.49 (30.19%)	12.09±0.34 (40.29%)
50%	11.17±0.28 (47.46%)	7.02±0.34 (24.10%)	66.07±0.47 (19.45%)	17.23±0.15 (14.91%)
Control	21.26±0.12	9.25±0.23	82.03±0.27	20.25±0.23

Values in parentheses are per cent nhibition over the control. Length of pollen tubes were estimated in numbers of pollen grain diameters. Significant to't' test, mean ± t (0.05)×SEM, DF=4.0



Pl. = Pollen grains, ger.=germination, con.=leachate concentration

Fig. 1 : Per cent inhibition (over the control) in pollen germination of *Phaseolus mungo* and *Zea mays* after 12 and 24 hours at 50% and 100% leachate concentration



Pl. = Pollen grains, tu.=tube, ger.=germination, con.=leachate concentration

Fig. 2 : Per cent inhibition (over the control) in pollen tube growth of *Phaseolus mungo* and *Zea mays* after 12 and 24 hours at 50% and 100% leachate concentration

grain, which are generally covered with only a very thin layer of exine. The first event associated with the germination is hydration and swelling of the outer pectic layer of the intine, which leads to the rupture of exine. Almost the entire contents of the grain move into the tube. Rapid growth of the tube is restricted to the tip region. In the growing tube, most of the cytoplasm is confined to the apical region and a large vacuole fills the grains and the older region of the tube. To restrict the cytoplasm to the apical region of the growing tube, a series of callose plugs are formed at a regular distance behind the tip. As a result, a fully grown pollen tube is sub divided into many compartments. Allelochemicals leaching from the pollen grains of *Parthenium hysterophorus* might be interferring with the activation of pollen grains before the emergence of pollen tube from the germ pore resulting in poor germination. In growing pollen tube, callose plug restrict cytoplasm at the tip.Therefore, active growth is found at the tip. Allelochemicals might interfere in the formation of callose plug resulting in poor growth of pollen tubes.

Effect of fungicides on pollen germination and pollen tube growth were also reported by various workers: Watter and Sturgeoen, (1990) for apples, Radalen, (1980) for raspberries, Bristow and Shawa, (1981) for cranberries, Wetzstein, (1990) for pecans, Abott *et al.* (1991) for *Tradescantia*, Church and Williams, (1978) for apples. Some pollen tubes of *Phaseolus mungo* which were found thin and distorted in 100% leachate might be due to rupturing of pollen tubes in the presence of allelochemicals. Similar result was also reported by He *et al.* (1996) *i.e.* rupturing of pollen tubes after exposure to benomyl.

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