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RESEARCH ARTICLE

ALLELOPATHIC POTENTIAL OF *AGERATUM CONYZOIDES* L. ON GROWTH AND DEVELOPMENT OF *PISUM SATIVUM* L

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ABSTRACT

The field experiments were conducted in the field of Botany department of C.C.S. university campus, Meerut in the month of November to January (2018). 10%, 20% and 30% of aqueous extracts prepared from weed species namely *Ageratum conyzoides* L. used for the present investigation to determine their allelopathic potential on growth and, developmental changes of *Pisum sativum* L. The weed extracts showed a positive effect on soil parameters (pH, CEC) at 30% extract. However, 10% extract induced the physiological parameters of pea plant such as germination percentage, root and shoot growth, nodulation, biomass production, and moisture content. The extracts of *Ageratum conyzoides* have more positive effect at 10% concentration on pea crop.

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INTRODUCTION

Pea (*Pisum sativum* L.) is a crucial legume propagates as a garden and field crop ubiquitously to the temperate regions of the earth (Shrestha *et al*. 2011, Dhital *et al.,* 2017). Pea is a member of family Fabaceae, placed under genus *Pisum* (2n = 14). It is a best source of the protein (23 to 25%) having essential amino acids that have high nutritional values. Additionally, some essential minerals such as phosphorous, iron, and calcium are present in rich quantities in pea which are deficient in cereals (Haque, 2014). It contains 20-25% starch, 4-10% sugar, 0.6-1.5% fat and 2-4% minerals (Makasheva, 1983). The high protein content of legumes is due to their unique ability to associate with symbiotic bacteria (rhizobia) that inhabit in root nodules (Dilworth *et al*., 2008). Rhizobia convert atmospheric nitrogen gas into ammonia which serves as limiting building blocks for amino acids like leucine, lysine, valine, tryptohan, methionine, etc. (Broughton *et al*., 2003). This process is called biological nitrogen fixation (Dilworth *et al.,* 2008). Modern agriculture is now challenged with the need to reduce health hazards and environmental damage, Modern agriculture is a result of the use of agrochemicals such as herbicides, insecticides, and fungicides without affecting levels of production (Kropff and Walter, 2000). Applying allelopathy in agricultural ecosystems and in natural ecosystems (e.g. weeds) has been Beneficial (Inderjit and Foy, 1999). However, involving allelopathy system with cereals and legumes has received limited attention. Allelopathic effects in legumes and cereals have been proposed as a strategy to suppress weeds (Conklin *et al.,* 2002), pests and diseases (Messiaen, 1994), pollution (Narwal *et al*., 1998) and to minimize the input of agrochemicals or synthetic fertilizers were for enhances the crop productivity. It is, therefore, possible to utilize allelopathic interactions as a cost-effective alternative to external inputs and thus contribute to sustainable agriculture (Wu *et al.,* 1999). Plant *Ageratum conyzoides* is a member of family Asteraceae tribe Eupatoriae. The genus *Ageratum* consists of approximately 30 species but only a few species have been phytochemically investigated (Kamboj *et al.,* 2008). Volatile oil and aqueous extract of the *Ageratum conyzoides* have been shown to have allelopathic effects on a number of cultivated crops. Shabana *et al., (*1991); Xuan *et al.,* (2004) were reported many phenolics compounds like gallic acid, coumaric acid, protocatechuic acid, p-coumaric acid, sinapic acid, and benzoic acid are secretes by *Ageratum conyzoides* which shows allelopathic effect on the other crops plants.

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Although considerable work has been done on Allelopathy, much of this work has been concentrated on legumes (Inderjit *et al.,* 1995). A more focused approach to the effect of allelochemicals on soil and physiological properties is needed. The question of whether allelochemicals leached from foliage/litter influence soil properties still remains unanswered. Little is known about what chemical properties of soil are likely to be affected by phenolic compounds (flavonoids, alkaloids, chromenes, phenolics and essential oils) released in the crop by extract/leachate treatment. Therefore, there is a need to explore and understand the allelochemicals and their effects on legumes, and their interactions with soil properties.
The major objective of the present study was to check the potential of allelochemicals obtain from aqueous extract of *Ageratum conyzoides* and their effects on some physiological parameters of *Pisum sativum* L.

MATERIALS AND METHODS

The field experiment was conducted during the Rabi season in the month of November to January during 2017-2018 in department of botany C.C.S. University Campus, Meerut U.P. India.

Preparation of stock solution of *Ageratum conyzoides* leachate: For the preparation of the stock solution of *Ageratum conyzoides,* collect fully mature plants from C.C.S. University Campus, Meerut. Plants were washed in the running tap water and dried in the air at room temperature. The whole plant was cut into small pieces and weight 400 gm plant biomass. After that this biomass was soaked in 1000 ml of demineralization water. Kept it for 48 hours at room temperature with occasional shaking. The infusion was decanted and filtered with three layers of cheesecloth and Whatman No.1 filter paper. By this method, 40% stock solution was prepared. Further dilute 40% stock solution with demineralization water and prepared 0, 10, 20, and 30% extract of the *Ageratum conyzoides* solutions. 50 healthy seeds of pea (Pusa pargati) were sown in 4 plots of area 1 x 1m^2. Each plot was irrigated with an equal quantity of weed extracts (0, 10, 20, and 30%) after the seed sown.

Recorded data

pH: pH of soil was measured by the method as adopted by Covington (2009).

Cation exchange capacity: CEC of soil was measured by the method of Jones (1967).

Seed Germination Assay by ISTA (1976):

Moisture content: Moisture content of the plant was measured by the method adopted by Reeb (1999).

Nodulation and biomass production: These parameters was measured by the method as adopted by Priti (2018)

RESULT AND DISSCUSSION

pH of soil: However, *Ageratum conyzoides* extract treated soil pH gradually decreases from 0% to 30% (7.63, 7.51, 7.45, and 7.25 respectively) (Table 1). pH values of all treated plots with the extract of *Ageratum conyzoides* was less in comparison to control.

Table 1. Effect of aqueous weed extracts of *Ageratum conyzoides* on the pH and CEC value of soil.

Concentration %	pH	CEC
0 % extract	7.63	11.22
10 % extract	7.51	10.56
20% extract	7.45	10.12
30% extract	7.25	9.24

Table 2. Effect of aqueous weed extracts of *Ageratum conyzoides* on the germination % of *Pisum sativum*

	Germination %		
Concentration %	7 day after sown	14 day after sown	21 day after sown
0 % extract	37	39	44
10 % extract	40	46	45
20% extract	30	40	45
30% extract	29	40	42

Table 3. Effect of aqueous weed extracts of *Ageratum conyzoides* on the plant length (cm) of *Pisum sativum*

Concentration %	Root length	Shoot length	Total length
0 % extract	14.82	38.02	52.84
10 % extract	16.96	42.09	59.05
20% extract	15.96	36.00	51.96
30% extract	15.78	36.00	51.78

Table 4. Effect of aqueous weed extracts of *Ageratum conyzoides* on the nodulation parameters of *Pisum sativum*

	Nodulation parameters		
Concentration %	Number (no.)	Weight (g.)	Volume (ml)
0 % extract	44	0.196	0.686
10 % extract	73	0.204	0.718
20% extract	35	0.196	0.672
30% extract	34	0.19	0.672

Table 5. Effect of aqueous weed extracts of *Ageratum conyzoides* on the biomass production (gm) and moisture content (gm/ml) of *Pisum sativum*

Concentration %	Root			Shoot		
	Fresh weight (gm)	Dry weight (gm)	Moisture content (gm)	Fresh weight (gm)	Dry weight (gm)	Moisture content (gm)
0 % extract	0.517	0.155	0.362	5.322	1.065	4.257
10 % extract	0.618	0.170	0.448	6.017	1.078	4.939
20% extract	0.431	0.140	0.291	5.273	1.175	4.098
30% extract	0.426	0.138	0.288	5.056	0.994	4.062

The concentration of *Ageratum conyzoides* extract increases the acidic nature of soil proportionally. It may be due to the phenolic compounds which present in *Ageratum conyzoides* extracts (Dalton *et al.,* 1983). Because the amount of organic carbon, organic matter and available nutrients increasing after amended the soil with weed extract of *Ageratum conyzoides*. Besides this, the extract of *Ageratum conyzoides also* changes the physicochemical properties of soil. Increased content of organic matter in the extract amended soil indicates lesser microbial activity because nitrogen-fixing bacteria cannot withstand in acidic condition. Moderate changes in pH modify the ionization of amino-acids functional groups and disrupt hydrogen bonding, which in turn, promotes changes in the folding of the biomolecule (which are necessary for biosynthesis and metabolic activities of plant). It promots denaturation and destroying activity of ions. It is in agreement with earlier reports by Okunade (2002) and Dogra (2009a).

Cation exchange capacity: The maximum cation exchange capacity of soil was observed in the control (11.22) as compared to all *Ageratum conyzoides* extracts treated plots. As the concentration of the weed extract increased from 10 to 30% the CEC of soil was decreased (10.56-9.24) (Table-1). Being low cation exchange capacity of *Ageratum conyzoides* extracts is the reason for the reduction in CEC values of treated plots. This could be due to the acidic nature of polyphenols or phenolic compounds which are present in the *Ageratum conyzoides* extract. These phenolic compounds cause acidification of soil which in turn causes the loss of base cations and reduces the CEC of soil. Such kind of results was also observed by Mugai *et al*. (2008)

Germination %: *Ageratum* plants extract at lower concentration (10%) induced more germination at initial stage (their 7 days of shown) of pea seeds in comparison to control. But at the higher concentrations, the extract reduces the germination % (Table 2). After 14 days, the germination % was found maximum (46) in 10 % extract treated plot in comparison to the 0, 20, and 30 % treated plots respectively. In third observation (after 21 days of sown) the germination % did not show more differences. However, the 30% extract of *Ageratum* treated plots shows minimum germination % (42) in comparisons to all other treated plots included control. Higher contents of allelochemicals present in *Ageratum conyzoides* extracts may be responsible for promoting the germination % at an initial stage (7 days). But as the concentration increases the germination % decreases due to the inhibitory effects of the higher amount of allelochemicals like flavonoids, alkaloids, chromenes, phenolics and essential oils present in the whole plant. Several environmental factors such as, soil moisture regime, soil temperature alternate wetting, drying of the soil, soil nitrate level also affect the seed germination % (Reigosa *et al.,* 1999). Such similar kind of results was also observed by Bhatt *et al.* (2001), Oudhia and Tripathi, (2001).

Plant Lenght: Shoot and root lengths of pea plant inhibited at higher concentration of *Ageratum conyzoides* plant extract. But in case of 10% extract the root and shoot length was stimulated in pea plant. The highly significant assistance of root and shoot growth of test crop indicated the positive allelopathic effect of *Ageratum Conyzoides* plant extract. There may be the reason, the presence of gallic acids, ferulic acids, and p-coumaric acid assist the legumes plant growth (Li *et al.,* 2010). However, as the concentration of the weed extract increases the height of plant decreases (Table 3). Reduction in plant height may be due to the imbalance of water uptake or osmotic pressure of the tissues by the allelochemicals toxicity of the extracts (Blum *et al.,* 1999). Similar kind of results was also observed by Natarajan *et al.* (2014).

Nodulation: All the nodule attributes (number, weight, and volume of the nodules) was found maximum at 10% *Ageratum conyzoides* leachate treated plots in comparison to remaining other treated plots and over the control. However, 20 and 30% *Ageratum conyzoides* extract treated plots have the almost same values of nodulation parameters. Howeve, both of the treated plots shows minimum values (Table 4) over the control and 10% extract treated plots. Nodulation was significantly inhibited in *Ageratum conyzoides* extracts amended soils at higher concentrations. It is, however, difficult to say whether the failure of nodulation is due to lack of root hair formation or inhibition of the activity of bacteria responsible for nodulation. *Ageratum conyzoides* has various chemical compounds such as coumaric acid, gallic acid, ferulic acid, hydroxybenzoic acid, anisic acid and syringic acid. Their presence in different parts of weed may be responsible for an inhibitory effect on the test plants. All these results show that the *Ageratum conyzoides* exert an inhibitory effect on nodulation of the plant through the release of allelochemicals in soil from its different parts (Laur, 2008). These allelochemicals besides imparting the plant allelopathic property also regulate the biotic communities like Rhizobacteria, nematoad, algae and other microbes of soil and change the physical and chemical properties of soil which ultimately affect the microbial population of soil. The nodulation of plants got affected by the degradation of microbial flora. Similar kinds of result have also been reported by Batish *et al.* (2006).

Biomass and moisture content of plant: 10% *Ageratum conyzoides* extract treated plots shows higher biomass and moisture content values in comparison to other remaining treated plots including control (Table 5). As the *Ageratum conyzoides* leachate concentration increases, biomass and moisture content values of plants decreases. The reduction in the biomass production and moisture content may be due to the imbalance of water uptake or osmotic pressure of the tissues. It may be due to the allelochemicals toxicity exhibited by *Ageratum conyzoides* extracts (Drost and Doll, 1980). It shows a direct involvement of the phenolics released by the *Ageratum* conyzoides extracts. These phenolics may also interfere with the process of nutrient uptake and transport (Baziramakenga *et al.,* 1994) or immobilization of the nutrients in the soil (Castells *et al.,* 2005) which reduce the biomass and moisture content of the plants. Based on these observations, the present study concludes that the extract of *Ageratum conyzoides* deleteriously affects the biomass production in pea crop by releasing water-soluble phenolic acids into the soil environment (Blum *et al.,* 1999). Similar kinds of results also observed by the Natarajan, (2014).

Conclusion

Allelopathy plays a key role both in natural and man managed ecosystems. Even though allelopathy concentration decides both negative and positive effects of the other crops plant. Most of the studies seem to be focused only on its deleterious impacts alone. In the present study, the aqueous extracts of *Ageratum conyzoides* at 10% show a positive impact on seed germination % at the initial or later stages of the pea seeds. The lower concentration of the *Ageratum conyzoides* extract also stimulates the growth and nodulation parameters. However, higher % of *Ageratum conyzoides* weed extracts lowers the pH and CEC values of soil. The present results show positive allelopathic effects of *Ageratum conyzoides* at lower concentrations. We can conclude and suggest by the present study that the *Ageratum conyzoides* weed has the potential as a green manure at a lower concentration. But more research work needed to evaluate the potential *of Ageratum conyzoides* as a green manure to enhance the crop productivity.

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