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Allelopathic Effect of Fruit Trees on Traditional Agriculture Crops of Garhwal Region

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ABSTRACT

Allelopathic effect of bark and leaves of *Malus domestica*, *Prunus persica* and *Prunus domestica* was evaluated on germination of three agriculture crops viz., *Triticum aestivum, Echinochola frumentacea* and *Elusine coracana*. Results revealed both stimulatory and inhibitory effect of aqueous extracts on germination and growth performance of *T. aestivum, E. frumentacea* and *E. coracana.* Leaf extract (10%) of *P. domestica* was found more toxic for germination but the bark extract (5%) of *P. domestica* showed more stimulatory effect as compared to the other trees. In different leaf and bark extract of all the fruit trees *E. frumentacea* was more resistant than *E. coracana* and *T. aestivum* respectively. Leaf and bark extract of *M. domestica, P. persica* and *P. domestica* exhibited the maximum germination percent (88%, 90% and 92%) respectively at lower (2% and 5%) concentrations while, the minimum germination percent (47%, 38% and 58%) were found in higher (10%) concentration. These fruit trees have inhibitory effects at higher concentration but stimulatory effects observed at lower concentration. The tolerance of the crops was in the order of *E. frumentacea*> *E. coracana*> *T. aestivum* as compared to the control. In leaf extract the toxicity of the fruit trees was in the order of *P. domestica*> *M. domestica*> *P. persica* whereas in bark extract toxicity was *M. domestica*> *P. persica*> *P. domestica* on all the test crops.

Key Words:

Agriculture crops, Allelopathic effect, bark extract, fruit trees, germination, leaf extract

INTRODUCTION

Allelopathic interaction in tree crop associations in agroforestry greatly influences the crop production (Ashrafi et al 2007). The term allelopathy was coined by Molish (1937) include both harmful and beneficial biochemical interaction between all types of plants including micro-organisms. Allelopathy is an important mechanism of plant interference and is mediated through the addition of chemicals to the plant environment. Muller (1969) suggested the term interference of one plant (including micro-organism) on another. However, compared to forest tree species, the agroforestry tree species have been investigated for alleloapathic influences. Agroforestry system has a potential to increase

yield. Allelopathic is the term to describe biochemical interaction that inhibits the growth of neighboring plants by another plant (Willis 2010).

There are many tree species grown around or in between cultivated fields in Uttarakhand. These species are used as fuel, fodder or fruits by the local people. So there is a need to screen commonly grown tree species in agroforestry for their allelopathic influences. The present investigation was carried out to evaluate the allelopathic effect of three Fruit trees *viz. Prunus domestica, Prunus persica* and *Malus domestica* on three traditional agriculture crops viz, Barnyard millet (*Echinochloa frumentacea*), Finger millet (*Eleusine coracana*) and Wheat (*Triticum aestivum*).

MATERIALS AND METHODS

The lab parameters were carried out in Forestry Laboratory of Department of Forestry, whereas field work was done in nursery of College of Forestry, Ranichauri (30° 15' N Latitude, 78° 30'E Longitude and at an altitude 2000 masl) during Sep 2017 to April 2018. Leaves and barks of Apple (*Malus domestica*), Plum (*Prunus domestica*) and Peach (*Prunus persica*) were collected within the campus of College of Forestry, Ranichauri. Seeds of three traditional agriculture crops *i.e, Eleusine coracana*, *Echinochola frumentaceae* and *Triticum aestivum* were taken from Department of Crop Improvement, College of Forestry, Ranichauri. Healthy leaves and barks were collected from the selected trees. The samples were sun dried for one week. Dried barks and leaves were powdered with the help of mechanical grinder and stored for experimental use. Aqueous extract was prepared by soaking 20g, 50g, and 100g of dry bark and leaves powder in 1000 ml of distilled water for 24 hours at room temperature. The resultant solution was then filtered with a three layer of whatman filter paper no. 1and stored in a conical flask. Thereafter 2, 5 and 10 percent aqueous extract were prepared separately for each component.

The effect of extract on percent germination of three agriculture crops was recorded. For each test species, 20 seeds were placed on germination paper in petri dishes (9 cm diameter), each containing aqueous extract for treatment and distilled water as control. Moisture in the petridishes was maintained by adding extract or distilled water as required. Germination percentage was recorded at the completion of the test period, *i.e.* 7 days after sowing.

The field experiment was conducted in Randomized Block Design (RBD) with five replications of each species *i.e. M. domestica*, *P. domestica* and *P. persica*. Before sowing of test crop seeds in nursery, poly bags were filled with mixture made of sand, soil and FYM in the ratio of 1:2:1. In each treatment 25 poly bags were treated. Four seeds of each test crop were sown in poly bags. Each poly bag was irrigated with leaf and bark extract of different concentrations (i.e 2%, 5%, 10%) and distilled water was used as a control. All the bags were kept under partial shade. Germination percentage was estimated at the completion of the test period, *i.e.* 21 days after sowing. Data were analyzed by application of ANOVA using the WASP statistical software, WASP version 1.0 (ICAR GOA, India).

RESULTS AND DISCUSSION

The observations recorded under laboratory and field conditions were analyzed separately. The results on the allelopathic effect of leaf and bark (2%, 5%, and 10%) extract of *M. domestica, P. persica* and *P. domestica* on the germination of test crops under laboratory conditionswere presented in Table 1. In leaf and bark extract of *M. domestica*, maximum (91%) germination was found in *E. frumentacea* under the control condition. The minimum (41%) germination in *E. coracana* under 5% leaf extract of *M. domestica* in which germination was reduced as compared to control in bark extract the maximum (91%) germination was found in control of *E. frumentacea* while minimum (47%) germination was found in *E. coracana* under 10% bark extract. Significant results were observed in leaf extract for

Table 1. Effect of leaf and bark extract of *M. domestica*, *P. pursica* and *P. domestica* on germination of test crops under laboratory conditions.

Fruit trees/Extract levels	Test crops		
	Triticum aestivum	*Echinochloa frumentacea*	*Eleusine coracana*
Malus domestica			
Leaf Control	80^{ab}	91^{a}	55^{a}
2%	87^{a} (+8.75)	88^{a} (-3.29)	57^{a} (+3.63)
5%	72^{b} (-10)	77^{b} (-15.38)	41^{b} (-25.45)
10%	70^{b} (-12.50)	76^{b} (-16.48)	53^{a} (-3.63)
Mean	77.25	83	51.50
Bark Control	80^{ab}	91^{a}	55^{a}
2%	70^{b} (-12.5)	84^{a} (-7.69)	66^{a} (+20)
5%	71^{a} (-11.25)	80^{a} (-12.08)	53^{b} (-3.63)
10%	65^{b} (-18.75)	84^{a} (-7.69)	47^{b} (-14.54)
Mean	71.50	84.75	55.25
Prunus persica			
Leaf Control	80^{a}	91^{a}	55^{a}
2%	77^{a} (-3.75)	82^{b} (-9.89)	46^{b} (-16.36)
5%	86^{a} (+7.50)	79^{b} (-13.18)	40^{b} (-27.27)
10%	78^{a} (-2.50)	81^{b} (-10.98)	38^{b} (-30.90)
Mean	80.25	83.25	44.75
Bark Control	80^{a}	91^{a}	55^{a}
2%	80^{a} (0)	85^{a} (-6.59)	65^{bc} (+10.98)
5%	83^{a} (+3.75)	80^{a} (12.08)	69^{ab} (+25.45)
10%	66^{b} (-17.50)	80^{a} (12.08)	80^{a} (+45.45)
Mean	77.25	84	67.25
Prunus domestica			
Leaf Control	80^{ab}	91^{a}	55^{a}
2%	73^{b} (-8.75)	82^{b} (-9.89)	53^{a} (-3.63)
5%	71^{b} (-11.25)	87^{ab} (-4.39)	54^{a} (-1.81)
10%	62^{c} (-21.95)	74^{c} (-18.68)	60^{a} (9.09)
Mean	71.50	83.50	55.50
Bark Control	80^{ab}	91^{a}	55^{a}
2%	78^{ab} (2.50)	82^{ab} (-9.89)	55^{a} (0)
5%	71^{ab} (-11.25)	74^{b} (-18.68)	46^{a} (-16.36)
10%	70^{ab} (-12.50)	80^{b} (-12.08)	54^{a} (-1.81)
Mean	74.75	81.75	52.50

*(+ and - signs indicate % stimulation (+) and % inhibition (-) in percent germination over control. Different letters in column indicate significant difference among treatments at $P<0.05$.)

Table 2. . Effect of leaf and bark extract of *M. domestica, P. persica* and *P. domestica* on germination of test crops under nursery conditions.

Fruit trees/Extract levels	Test crops		
	Triticum aestivum	*Echinochloa frumentacea*	*Eleusine coracana*
Malus domestica			
Leaf Control	87[a]	65[b]	60[b]
2%	82[a] (-5.74)	74[ab] (+13.84)	72[a] (+20)
5%	88[a] (+1.14)	81[a] (+24.61)	51[c] (-15)
10%	81[a] (-6.89)	65[b] (0)	52[c] (-13.33)
Mean	84.50	71.25 [b]	58.75 [b]
Bark Control	87[a]	65	60
2%	70[c] (-19.54)	50[b] (-23.07)	55[b] (-8.33)
5%	77[b] (-11.49)	52[b] (-20)	53[b] (-11.66)
10%	87[a] (0)	73[a] (+12.30)	50[b] (-16.66)
Mean	80.25	60	54.50
Prunus persica			
Leaf Control	87[a]	65[a]	60[a]
2%	86[a] (-1.14)	84[a] (+29.23)	70[a] (+16.66)
5%	90[a] (+3.44)	67[b] (+3.07)	71[a] (+18.33)
10%	90[a] (+3.44)	86[a] (+32.30)	55[b] (-8.33)
Mean	88.25	75.50	64
Bark Control	87[a]	65[a]	60[a]
2%	77[bc] (-11.49)	62[a] (-4.61)	56[a] (-6.66)
5%	74[c] (-14.94)	67[a] (+3.07)	60[a] (0)
10%	84[ab] (-3.44)	67[a] (3.07)	50[a] (-16.66)
Mean	80.50	65.25	56.50
Prunus domestica			
Leaf Control	87[a]	65[b]	60[b]
2%	71[b] (-18.39)	57[a] (-12.30)	58[b] (-3.33)
5%	86[a] (-1.14)	64[a] (-1.53)	71[a] (+18.33)
10%	85[a] (-2.29)	57[a] (-12.30)	58[b] (-3.33)
Mean	82.25	60.75	61.75
Bark Control	87[a]	65[b]	60[b]
2%	91[a] (+4.59)	54[c] (-16.92)	72[a] (+20)
5%	92[a] (+5.14)	77[a] (+18.46)	79[a] (+31.66)
10%	75[b] (-13.79)	52[c] (-20)	60[b] (0)
Mean	86.25	62	67.75

*(+ and - signs indicate % stimulation (+) and % inhibition (-) in percent germination over control. Different letters in column indicate significant difference among treatments at $P<0.05$.)

E. coracana and *E. frumentacea* while in bark extract non-significant results were obtained for all the test crops. In leaf and bark extract of *P. persica*, data showed that the maximum (91%) germination was found in *E. frumentacea* under control while the minimum (38%) germination was found in *E. coracana* under 10% leaf extract. Among all the bark extracts, the maximum (91%) and the minimum (55%) germination was found in *E. frumentacea* and *E. coracana* under control condition. Significant results were seen in case of germination percent for all the test crops under bark extract except *E. frumentacea* while in leaf extract there is no significant results except in *E. coracana.* In leaf and bark extract of *P. domestica,* percent germination showed that the maximum (91%) and minimum (62%) germination in *E. frumentacea* under control and *T. aestivum* under 10% leaf extract. In bark extract maximum and minimum (91) or (74%) germination was found in *E. frumentacea* under control and 5% bark extract. There were no significant results observed for germination percent except in *T. aestivum* and *E. frumentacea* for leaf extract, while for bark extract no significant results were noticed.

Data on leaf and bark extract of *M. domestica, P. persica* and *P. domestica* on percent germination of test crops under nursery conditions were showed in Table 2. In leaf and bark extract of *M. domestica* results revealed that maximum (88%) germination was recorded in *T. aestivum* under 5% leaf extract while minimum (51%) germination was recorded in *E. coracana* under 5% leaf extract. In bark extract maximum (87%) germination was found in *T. aestivum* under control and 10% bark extract whereas minimum germination (50%) was found in *E. frumentacea* under 2% bark extract. Significant results were noticed in leaf extract of *M. domestica* for all test crops except *T. aestivum* and *E. frumentacea* while in bark extract of *M. domestica* significant results were obtained for all test crops except E. *coracana.* In leaf and bark extract of *P. persica* germination percent was recorded maximum (86%) and minimum (55%) in *E. frumentacea* and *E. coracana* under 10% leaf extract. In bark extract, the maximum (87%) germination was found in *T. aestivum* under control whereas minimum (74%) germination was found in *T. aestivum* under 5% extract. Non-significant results were noticed in bark extract for all the crops while in leaf extract significant results were obtained in only *T. aestivum.* In leaf and bark extract of *P. domestica* maximum (87%) germination was recorded in *T. aestivum* under control while minimum (58%) germination was found in *E. coracana* under 2% and 10% leaf extract. Among all the bark extracts maximum (92%) germination was found in *T. aestivum* under 5% extract whereas minimum (52%) germination was found in *E. frumentacea* under 10% bark extract. There were no significant results observed in case of standard germination for all the test crops under leaf extract while in bark extract there is significant results except in *T. aestivum.* The study revealed that the allelopathic effect of aqueous leaf and bark extract might be due to the presence of allelochemicals. The phytotoxic influences of agroforestry tree crops might be due to the presence of tannins, phenolics and other secondary metabolities found in various plant parts (Levin et al 1978, Amoo et al 2008 and Singh et al 2008). Leaf and bark extract have inhibitory effect at higher concentration but low concentration have stimulatory effects reported by (Uniyal and Chhetri 2010; Ahmad et al 2014 and Naik 2017).

CONCLUSION

Different concentrations of leaves and bark extract of Malus domestica, Prunus persica and Prunus domestica in both laboratory and field conditions caused both stimulatory and inhibitory effect on germination and growth performance of Triticum aestivum, Echinochola frumentacea and Elusine coracana. In different concentrations of bark extracts the toxicity of the fruit trees were seen in the order of *M. domestica> P. persica> P. domestica;* while in leaf extract it was in the order of *P. domestica> M. domestica> P. persica on T. aestivum*, *E. coracana* and *E. frumentacea.*

REFERENCES

Ahmad I, Hussain F Barkatullah and Ahmad B. 2014. Phytotoxic potential of *Celtis australis* L. (family Ulmaceae) against four crop species. Pakistan Journal Botany 46(6): 2063-2067.

Amoo SO, Ojo AU and Staden JV. 2008. Allelopathic potential of *Tetrapleura tetraptera* leaf extracts on early seedling growth of five agriculture crops. South African Journal of Botany 74: 149-152.

Ashrafi Z, Mashhadi HR and Sadeghi S. 2007. Allelopathic effects of Barley (*Hordeum vulgare*) on germination and growth of Wild Varley (*Hordeum spontaneum*). Pakistan Journal of Weed Science Research 13:99-112.

Levin DA, York JR and Billie M. 1978. The toxicity of plant alkaloids: an ecogeographic perspective. Biochemical Systematics and Ecology 6:61-76.

Molish H. 1937. Der EinflusscinerPflanz auf die andere- Allelopathic. Edition Classic. VDM Verlag, Dr. Mullar. Esther von Krosigk. 116.

Muller CH. 1969. Allelopathy as a factor in ecological process. Vegetation 18: 348-57.

Naik PG. 2017. Allelopathic effect of three agroforestry tree species on traditional agriculture crops of Garhwal Himalays, Thesis, M.Sc. V.C.S.G. University of Horticulture and Forestry, TehriGarhwal, (U.K.) 87p.

Singh B, Uniyal AK and Todaria NP. 2008. Phytotoxic effects of tree species on field crops. Range Management and Agroforestry 29(2): 104-108.

Uniyal A K, and Chhetri S. 2010. An assessment of phytotoxic potential of promising agoforestry trees on germination and growth pattern of traditional field crops of Sikkim Himalaya, India. Am-Euras. Journal of Scientific Research 5(4): 249-256.

Willis RJ. 2010. The Historical base of the concept of allelopathy. Journal of History of Biology18: 71-102.