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APPLICATION OF *PROSOPIS JULIFLORA* (Sw.) DC. EXTRACTS IN THE MANAGEMENT OF ROOT INFECTING FUNGI OF COWPEA AND MUNGBEAN

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ABSTRACT

Research work carried out to find the efficacy of different concentrations of *Prosopis juliflora* (Sw.) DC aqueous extract in the management of root infecting fungi. All plants parts extract @100, 50 and 25% w/v showed significant suppression in the infection of root-rot fungi viz., *Fusarium* spp., *Rhizoctonia solani* and *Macrophomina phaseolina*. Growth parameters like shoot and root length, shoot and root weight, and leaf area increased in all the treatments as compared to the control. Where as the 50% extract of *P. juliflora* was most effective for the control of root-rot fungi of cowpea and mungbean plants and showed significant reduction of root rot fungi.

Key-words: *Prosopis juliflora*, plant extracts, root infecting fungi, cowpea, mungbean.

INTRODUCTION

Plant extracts represent a rich source of antimicrobial agents and have been used in medicine preventive, promotive and curative applications. Extracts of various plant parts are found to be effective against seed borne pathogenic fungi. Soil borne fungi causing seed damage at various growth stages of plant. Biological treatment can avoid losses due to diseases by seed borne pathogens and also provide sustainable and environmental friendly approach plant metabolites and plant based pesticides appear to be one of the better alternatives as they are known to have minimal environmental impact and danger to consumers in contrast to synthetic pesticides. Extracts of many higher plants have been reported to exhibit antifungal properties under laboratory trails (Mohana *et al*., 2011). Exploitation of plant metabolites in crop protection and prevention of biodeterioration caused by fungi appear to be promising. Plant extracts may be used as an alternative source for controlling soil-borne diseases since they comprises a rich source of bioactive substance (Windels and Lamey, 1998).

Protective, curative and antagonistic activity of different plants against variety of diseases has been reported by several workers (Kandasamy *et al*., 1974; Hale and Mathers, 1977; Rahber-Bhatti, 1986; Kalo and Taniguchi, 1987). Several higher plants and their constituents have shown success in plant disease control (Ashrafuzzaman and Hossain, 1992). The extracts of plants exhibited marked effect on germination of fungal spores as well (Singh *et al*. 1990, Dubey and Kishore, 1991), and it inhibited the fungal growth (Khair *et al*., 1995). Alkhail (2005) showed that aqueous extracts of plants viz., *Allium sativum*, *Cymbopogon proxims*, *Carum carvi*, *Azadirachta indica* and *Eugenia caryophyllus* had strong antifungal activity against fungi viz., *Fusarium oxysporum*, *Botrytis cinerea* and *Rhizoctonia solani*. Biological control of plant disease, is safe and sustainable (Cook and Baker, 1982, Janisiewiez and Korsten, 2002; Spadaro and Gullino, 2005; Sobowale, 2008). Various plants are known to have antimicrobial properties and these are used as promising biocontrol agents, (Grane and Ahmad, 1988; Wilson *et al*., 1997; Abd-Alla *et al*., 2001). *In vitro* study showed that an aqueous extracts from leaves of *Argemone Mexicana* Linn. showed anticancer activity (Kiranmayi *et al*., 2011) and antibacterial activity (Kempraj and Sumangala, 2010).

Mohanta *et al*. (2007) prepared the aqueous and organic solvent extracts of the plant *Semecarpus anacardium* Linn. showed inhibitory activity against *Staphylococcus aureus* . Natural plant products as environmentally safe option have received attention for controlling phytopathogenic diseases. Therefore, considerable research for biocides that are environmentally safe and easily biodegradable have been carried out during last two decades (Tegegne *et al*., 2008). *Prosopis juliflora* showed strong antimicrobial activity in vitro against 40 microorganisms which included 31 bacteria, two *Candida* species, five dermatophytic fungi and two viruses. Significant inhibitory effect was noted against Gram positive bacteria. (Aqeel *et al*., 1989). The object of this research is to study the efficacy of aqueous extract of *Prosopis juliflora* against common root infecting fungi on cowpea and mungbean.

MATERIALS AND METHOD

Collection of plant material :

Healthy non infected leaves, stem and flower of *Prosopis juliflora* (Sw.) DC. were collected from the campus of the University of Karachi. All plant parts were washed with distilled water to remove dust. After drying they were powdered by using an electric grinder.

Preparation of plant extract:

Ten g of the plant parts powder was added in water in the ratio of 1:2 (weight by volume). It was strained through muslin cloth. The extract was allowed to settle for a while and the supernatant was passed through Whatman's filter paper No.41 in to 50 ml Pyrex flask. The filtrate was used for the test. The concentration of the extract thus prepared was used as stock solution (100%). This stock solution was diluted by sterilized distilled water to prepare 50 and 25% concentrations.

Physical properties of soil:

The sandy loam soil contained 70% sand, 11% silt and 10% clay, and had a pH of 9.6 with 49% water-holding capacity (Keen and Raczkowski, 1922), 0.077–0.099% of total nitrogen (Mackenzie and Wallace, 1954). 3–7 sclerotia/g of *M. phaseolina* was isolated using the sieving technique (Sheikh and Ghaffar, 1975); 5–20% of *R. solani* on sorghum seeds was used as baits (Wilhelm, 1955) and *Fusarium* spp. 2000cfu g^{-1} was assessed by soil dilution technique (Nash and Snyder, 1962).

Seed treatment with plant extract:

Seeds of cowpea and mungbean were surface sterilized with 1% $Ca(OCl)_2$, air dried and soak in 100, 50 and 25% solutions for 10 minutes then air dried on blotter paper.

Soil drenching with aqueous plant extract:

Soil drenching with 25 mL aqueous extract of *P. juliflora* in each pot with different concentrations viz., 100 (stock solution), 50 and 25% of stock solutions.

Experimental set up in green house:

Plastic pots filled with 300g soil and five seeds treated as above were sown in each pot and watered regularly to maintain sufficient moisture. The pots were kept in screen house in randomized complete block design with three replicates per treatment. Seeds treated with sterilized distilled water served as control. Growth parameters like shoot and root lengths and weight, leaf area and number of nodules were recorded after 30 days of seed germination.

Detection of root rot fungi:

To determine the colonization of fungi in roots, plants were carefully uprooted and after washing in running tap water to remove soil, each root was cut into 5 pieces. These root pieces after surface sterilization with 1% $Ca(OCl)_2$, transferred on potato dextrose agar (PDA) poured plates. Plates were incubated at room temperature (28˚C) and after one week, infection of root colonization fungi were recorded from each root segment.

Data analysis:

Data were subjected to analysis of variance (ANOVA) followed by the least significant difference (LSD) test at P = 0.05, according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

COWPEA

Stock solution of *P. juliflora* showed significant enhancement of germination percentage ($P< 0.001$) when different concentrations of *P. juliflora* aqueous extracts were applied on seeds and in the soil. Shoot length of plants significantly ($P<0.001$) increased when seeds of cowpea treated with 100% aqueous extract of *P. juliflora* leaves as compared to soil drenching. Significant enhancement ($P< 0.01$) in the fresh weight of plants were observed when *P. juliflora* leaves extract applied @ 100% as compared to stem and flower extract. Root length significantly ($P< 0.01$) increased when crude extract of *P. juliflora* leaves applied on seeds. Fresh weight of root was significantly ($P< 0.05$) increased when 100% *P. juliflora* leaves extract used as compared to control. Maximum leaf area was observed when soil drenching with stock solution of *P. juliflora* leaves. Greater number of nodules were counted ($P<0.05$) when 100% extract of *P. juliflora* leaves was applied in the soil (Table 1). There was significant reduction in colonization percentage of root rot fungi *Fusarium* spp. ($P<0.001$) when pure extract of *P. juliflora* @ 100% applied on seeds and in soil. *Rhizoctonia solani* colonization on roots significantly ($P<0.001$) decreased when *P. juliflora* leaves extract applied in soil @ 100%. Stock extract of *P. juliflora* stem significantly ($P<0.001$) reduced the colonization of *Macrophomina phaseolina* on roots of cowpea (Table 3).

Table 1. Effects of seed treatment and soil drenching with aqueous extract of *Prosopis juliflora* on growth parameters of cowpea**.**

COWPEA (*Vigna unguiculata* L.)							
Treatments	**Germination (%)**	**Shoot length (cm)**	**Shoot weight (g)**	**Root length (cm)**	**Root weight (g)**	**Leaf area (cm^2)**	**Number of nodules**
SEED TREATMENT							
Control	80±10	9.66±0.5	1.6±0.0	4.0±0.5	0.4±0.2	10±0.3	2±0.5
Prosopis stem @ 100%	100±0.0	18.6±0.0	2.6±0.4	9.2±2.7	0.5±0.1	18±3.5	4±0.5
Prosopis stem @ 50%	100±0.0	19.8±1.1	2.6±0.2	10±1.5	0.7±0.1	17±1.0	3±0.3
Prosopis stem @ 25%	100±0.0	20.1±0.5	2.6±0.2	10±0.5	0.7±0.2	19±4.2	4±0.6
Prosopis leaves @ 100%	100±0.0	23.5±2.1	2.9±0.5	11±2.4	0.9±0.2	19±2.4	4±1.1
Prosopis leaves @ 50%	100±0.0	24.5±0.8	2.8±0.1	11±0.6	0.7±0.1	17±1.8	4±0.5
Prosopis leaves @ 25%	100±0.0	19.8±1.5	2.6±0.2	9.8±1.7	0.8±0.1	16±1.2	4±0.3
*Prosopis*flower @ 100%	100±0.0	21.3±1.3	2.6±0.1	10±1.1	0.8±0.1	18±0.5	3±0.5
*Prosopis*flower @ 50%	100±0.0	20.6±1.7	2.6±0.4	8.6±0.8	0.8±0.1	15±2.1	3±1.0
*Prosopis*flower @ 25%	100±0.0	22.3±1.1	2.4±0.2	8.2±0.5	0.8±0.1	18±1.7	4±0.6
SOIL DRENCHING							
Prosopis stem @ 100%	100±0.0	17.9±1.2	2.6±0.0	10±1.7	0.9±0.0	18±1.3	3±0.3
Prosopis stem @ 50%	100±0.0	23.2±0.9	2.8±0.3	8.7±3.6	0.6±0.1	17±1.0	3±1.2
Prosopis stem @ 25%	100±0.0	19.6±0.0	2.6±0.1	7.4±2.2	0.7±0.2	21±1.9	3±0.5
Prosopis leaves @ 100%	100±0.0	21.8±1.0	3.1±0.6	8.4±1.0	0.8±0.0	22±4.3	5±0.1
Prosopis leaves @ 50%	100±0.0	19.4±1.2	2.7±0.2	8.8±0.4	0.7±0.3	19±0.8	3±0.3
Prosopis leaves @ 25%	100±0.0	20.3±0.8	2.3±0.1	6.1±0.5	0.5±0.2	17±2.8	3±0.8
*Prosopis*flower @ 100%	100±0.0	19.5±0.6	2.8±0.1	8.1±0.9	0.6±0.2	18±1.0	3±0.5
*Prosopis*flower @ 50%	100±0.0	20.2±1.2	2.6±0.0	7.6±0.0	0.7±0.2	19±1.3	3±1.5
*Prosopis*flower @ 25%	100±0.0	18.8±1.7	2.6±0.1	7.7±0.1	0.8±0.2	18±0.8	4±1.3
$LSD_{0.05}$, Method	2.423	0.5047	0.1249	0.6483	0.160	1.03	0.394
$LSD_{0.05}$, Plant Parts	2.967	0.6182	0.1529	0.7940	0.196	1.26	0.483
$LSD_{0.05}$ Concen**.**	3.426	0.7138	0.1766	0.9169	0.227	1.45	0.557

MUNGBEAN

After one week of seed germination percentage of mung bean seedling was observed. There was 100% increase in germination percentage when *P. juliflora* parts extract applied on seeds and in soil. After 30 days of seeds germination growth parameters such as shoot and root length, fresh weight of root and shoot, leaf area and no. of nodules were recorded. Significant (P<0.001) enhancement in shot length was recorded when soil drenching with *P. juliflora* leaves extract. Fresh weight of plants significantly (P<0.001) increased when *P. juliflora* leaves extract drenched in soil as compared to seeds treatment. Significant enhancement (P<0.001) in root length was observed when seeds treated with *P. juliflora* leaves extract. Fresh weight of roots significantly (P<0.05) increased when 100% aqueous extract of *P. juliflora* leaves applied on seeds. Leaf area of mung bean plants significantly (P<0.01) increased when soil drenching with 100% aqueous extract of *P. juliflora* leaves as compared to seed treatment with *P. juliflora* parts @ 50 and 25%. Maximum number of nodules were recorded when seeds treated with *P. juliflora* leaves extract and soil drenching with stem extract (Table 2). Colonization of root rot fungi such as *Fusarium* spp., *Rhizoctonia solani* and *Macrophomina phaseolina* were significantly reduced when *P. juliflora* extract applied on seeds and in soil. Colonization percentage of *Fusarium* spp., significantly (P<0.05) reduced when *P. juliflora* stem extract used @ 100%. Suppression in colonization percentage of *R. solani* when pure extract of *P. juliflora* stem applied on seeds as compared to control (P<0.01). Significant (P<0.01) reduction in colonization percentage of *M. phaseolina* when seeds of mung bean treated with 100% extract of *P. juliflora* leaves (Table 4).

Table 2. Effects of seed treatment and soil drenching with aqueous extract of *Prosopis juliflora* on growth parameter of mungbean.

MUNGBEAN (*Vigna radiata* L.)							
Treatments	**Germination (%)**	**Shoot length (cm)**	**Shoot weight (g)**	**Root length (cm)**	**Root weight (g)**	**Leaf area (cm^2)**	**Number of nodules**
SEED TREATMENT							
Control	80±20	12.4±1.0	0.5±0.0	4.2±0.5	0.2±0.0	4.7±0.8	2±0.5
Prosopis stem @ 100%	100±0.0	18.6±3.5	1.4±0.3	9.0±2.0	0.3±0.1	9.5±0.6	4±1.7
Prosopis stem @ 50%	100±0.0	20.0±2.6	1.3±0.0	8.2±1.6	0.3±0.0	9.2±0.9	3±0.1
Prosopis stem @ 25%	100±0.0	20.2±0.8	1.4±0.2	8.2±1.2	0.4 ±0.1	8.9±0.8	4±1.5
Prosopis leaves @ 100%	100±0.0	21.2±1.6	1.4±0.1	9.9±0.9	0.5±0.0	8.3±0.5	4±1.5
Prosopis leaves @ 50%	100±0.0	20.6±1.3	1.2±0.1	9.1±1.2	0.3±0.0	10±1.8	5±1.3
Prosopis leaves @ 25%	100±0.0	20.4±0.5	1.1±0.0	9.2±1.7	0.4±0.1	9.4±0.5	3±0.1
Prosopis flower @ 100%	100±0.0	20.5±1.1	1.3±0.1	8.2±2.5	0.3±0.0	9.4±0.7	4±1.7
Prosopis flower @ 50%	100±0.0	20.1±1.9	1.3±0.1	9.9±2.3	0.4±0.0	9.1±1.0	4±1.0
Prosopis flower @ 25%	93.3±11	19.3±1.3	1.2±0.1	8.7±1.0	0.5±0.1	9.8±1.2	3±0.3
SOIL DRENCHING							
Prosopis stem @ 100%	100±0.0	21.8±0.6	1.2±0.0	10±1.6	0.3±0.0	9.4±0.4	3±0.1
Prosopis stem @ 50%	100±0.0	19.8±0.5	1.2±0.1	8.4±1.3	0.3±0.6	8.9±1.1	5±1.9
Prosopis stem @ 25%	100±0.0	21.7±0.5	1.1±0.0	10±2.1	0.3±0.0	9.3±0.3	5±1.5
Prosopis leaves @ 100%	100±0.0	18.5±1.6	1.4±0.4	6.7±0.6	0.4±0.0	12±1.1	4±0.3
Prosopis leaves @ 50%	100±0.0	23.6±2.0	1.7±0.1	9.2±0.6	0.4±0.1	10±1.9	4±0.6
Prosopis leaves @ 25%	100±0.0	18.6±1.1	1.2±0.0	6.6±0.3	0.3±0.0	9.6±1.1	3±0.1
Prosopis flower @ 100%	100±0.0	20.3±2.3	1.6±0.0	9.0±0.9	0.4±0.0	10±1.0	4±2.1
Prosopis flower @ 50%	100±0.0	20.6±0.6	1.5±0.1	9.6±1.7	0.5±0.0	11±1.2	4±1.0
Prosopis flower @ 25%	86.6±11	22.2±2.6	1.1±0.6	9.1±0.8	0.4±0.1	11±3.2	4±1.0
$LSD_{0.05}$, Method	4.724	0.7018	0.081	0.6218	0.042	0.64	0.538
$LSD_{0.05}$, Plant parts	4.091	0.8595	0.998	0.7615	0.051	0.78	0.659
$LSD_{0.05}$, Concen**.**	3.340	0.9925	0.115	0.879	0.059	0.09	0.761

Chandrashekhar *et al*. (2010) observed that aqueous extract of *Azadirachta indica, Argemone mexicana, Commiphora caudata, Mentha piperita, Emblica officinalis* and *Viscum album* were more effective in enhancing seed germination quality parameters and also in inducing resistance against downy mildew disease.

Donli and Dauda 2003 observed that when seeds of *Arachis hypogea* were soaked in aqueous *Moringa* seed extract at concentrations of 1, 5, 10, 15 and 20 g litre for 24 h. results showed that significant reduction in the incidence of fungi on the seeds, such reduction increasing as the dosage of aqueous *Moringa* seed extract increased. Results showed that all the concentrations brought about significant reduction in the incidence of fungi on the seeds such reduction increasing as the dosage of AMSE increased. *Mucor* sp. being the most sensitive and *Aspergillus niger* the least, with *Rhizopus stolonifer* and *Aspergillus flavus* intermediate.

All leguminous plants showed significant reduction in infection of root rot fungi when seeds treated and soil drenching with *P. juliflora* leaves extract @100% similar studies carried out by Akhter *et al*. (2006) that the extracts of *Adhatoda vasica* and *Zingiber officinale, Piper betle, Azadirachta indica* and *Vinca rosa* in combination with cow dung, and *Calotropis procera (*leaf) extract in combination with cow urine posses high ability to inhibit conidial germination of *Bipolaris sorokiniana.* Among all parts (stem, leaves and flower) *P. juliflora* leaves extract @100% showed significant reduction in infection of root rot fungi similar results observed by Suleiman and Emua (2009) that among *Zingiber officinale, Aloe ve*ra, *Garcinia cola* and *Azadirachta indica* extract *Aloe ve*ra showed 60% inhibition of mycelial growth of *Pythium aphanidermatum* .Mangang and Chhetry (2012) investigated that cold

water extracts of *Artemisia vulgaris, coixlacryma jobi, Lantana camera, Michelia champaka, Passiflora foetida, punica granatum and Strobilanthes flaccidifolius* showed 50% or more mycelial inhibition of *Rhizoctonia solani.* Coix lacryma jobish showed maximum percent of mycelia inhibition with respect to control. Similar studies carried out by Mohamed *et al*. (2013) that botanical extracts of garlic (*Allium sativum*) cloves and castor bean (*Ricinus communis*) seeds were more effective and significantly reduced nematode infection including number of galls and egg masses on roots of tomato compared to nematicide and non-treated plants.

Table 3. Effects of seed treatment and soil drenching with aqueous extract of *Prosopis juliflora* on root rot fungi.

COWPEA (*Vigna unguiculata* L.)			
Treatments	***Fusarium* spp.**	***Rhizoctonia solani***	***M. phaseolina***
SEED TRETMENT			
Control	100.0±0.00	100.0±0.00	100.0±0.00
Prosopis stem @ 100%	28.88±7.69	39.77±6.33	30.88±4.23
Prosopis stem @ 50%	44.44±13.8	46.44±13.3	26.66±1.15
Prosopis stem @ 25%	37.55±7.31	41.77±7.31	37.55 ±7.31
Prosopis leaves @ 100%	55.33±16.6	50.66±13.6	28.44±4.23
Prosopis leaves @ 50%	17.77±3.85	19.94±1.76	15.55±7.31
Prosopis leaves @ 25%	30.88±4.23	42.22±3.46	28.44±4.23
*Prosopis*flower @ 100%	39.77±6.33	33.11±4.00	26.44±6.67
*Prosopis*flower @ 50%	46.66±0.00	39.77±6.33	12.55±7.70
*Prosopis*flower @ 25%	26.44±6.67	26.66±1.76	19.99±1.76
SOIL DRENCHING			
Prosopis stem @ 100%	26.44±13.3	13.77±3.85	11.10±7.70
Prosopis stem @ 50%	24.22±16.7	17.33±9.28	19.77±6.33
Prosopis stem @ 25%	21.99±2.15	24.00±3.46	17.55±7.31
Prosopis leaves @ 100%	17.66±1.66	15.33±9.86	15.33±9.82
Prosopis leaves @ 50%	27.55±7.31	27.55±2.19	26.66±1.15
Prosopis leaves @ 25%	46.33±2.41	28.44±1.67	31.11±1.01
Prosopis flower @ 100%	37.77±2.36	17.55±6.86	39.77±6.33
Prosopis flower @ 50%	21.99±2.15	15.33±6.66	17.77±3.85
Prosopis flower @ 25%	64.33±7.50	53.33±1.75	24.44±7.69
$LSD_{0.05}$, Method	5.723	6.352	3.4753
$LSD_{0.05}$, Plant part	7.009	7.7806	4.2564
$LSD_{0.05}$, Concen**.**	8.094	8.984	4.9149

Experimental results showed that among 100%, 50% and 25% aqueous extracts of *P. juliflora* 100% and 50% aqueous extracts gave better results as compared to 25% aqueous extract. Adomako and Kwoseh (2013) observed that crude castor bean extract was nematotoxic to root-knot nematodes in vitro and in potted-tomato plants. crude castor bean aqueous extracts and its lower concentrations (20, 40 and 60%) caused significant improvement in plant growth measures such as height and fresh shoot weight. Bajwa *et al.* (2007) found that 2% aqueous extract of *Parthenium hysterophorus* L. root and shoot parts and 4% root and shoot aqueous extract of *Ageratum conyzoides* markedly suppressed the biomass of *Macrophomina phaseolina.* Jalander and Gachande (2012) reported that the leaf extract of *Datura stramonium* and *Datura innoxia* at 20% concentration was more inhibitory against *Fusarium oxysporum* and extract of *Datura stramonium* at 20% concentration was inhibitory against *Alternaria solani.*

CONCLUSION

The aim of present research is to provide useful information on cheaper, affordable, natural and environmental friendly plant such as *Prosopis juliflora* in the control of root rot diseases. Using plant resources for its antifungal activity is an attractive avenue for the development of sustainable mode of agriculture in organic farming system. Hence, new plants especially locally available need to be explored for their antifungal property.

Table 4. Effects of seed treatment and soil drenching with aqueous extract of *Prosopis juliflora* on root rot fungi.

MUNGBEAN (*Vigna radiata* L.)			
Treatments	***Fusarium* spp.**	***Rhizoctonia solani***	***M. phaseolina***
SEED TREATMENT			
Control	100±0.00	100±0.00	100±0.0
Prosopis stem @ 100%	28.44±16.47	12.33±7.50	17.77±3.85
Prosopis stem @ 50%	15.77±20.26	17.11±10.00	17.00±3.58
Prosopis stem @ 25%	15.88±16.47	40.99±11.54	13.33±6.67
Prosopis leaves @ 100%	13.80±16.47	41.66±14.01	11.10±7.70
Prosopis leaves @ 50%	19.77±6.33	22.00±3.40	15.55±3.85
Prosopis leaves @ 25%	28.88±27.75	22.00±3.64	15.55±7.70
*Prosopis*flower @ 100%	30.55±3.85	33.00±17.57	22.00±4.60
*Prosopis*flower @ 50%	20.33±9.82	30.88±21.19	35.55±3.85
*Prosopis*flower @ 25%	15.55±3.85	44.11±25.28	24.00±10.11
SOIL DRENCHING			
Prosopis stem @ 100%	13.10±11.16	22.22±16.78	13.33±6.67
Prosopis stem @ 50%	28.66±10.26	35.33±13.61	26.66±11.54
Prosopis stem @ 25%	33.00±17.57	35.55±3.85	33.33±0.00
Prosopis leaves @ 100%	22.00±3.46	15.55±6.67	8.88±3.85
Prosopis leaves @ 50%	26.00±0.00	19.77±10.18	17.55±9.89
Prosopis leaves @ 25%	30.88±16.47	31.11±10.18	30.88±4.23
*Prosopis*flower @ 100%	13.33±6.67	26.44±7.70	10.11±3.84
*Prosopis*flower @ 50%	28.88±7.69	31.33±6.33	17.55±7.31
*Prosopis*flower @ 25%	48.33±4.04	24.44±13.87	22.22±10.18
$LSD_{0.05}$, Method	5.414	5.2890	2.6952
$LSD_{0.05}$, Plant parts	6.631	6.4777	3.3009
$LSD_{0.05}$, Concen**.**	7.657	7.4798	3.8116

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