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Effect of plant extracts as pre-storage seed treatment on storage fungi, germination percentage and seedling vigour of pea (*Pisum sativum*)

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ABSRACT

Eleven plant extracts, viz. *Allium sativum* (garlic), *Adhatoda vasica* (malabar nut), *Vitex negundo* (horseshoe vitex), *Melia azadirachta* (chinaberry tree), *Tagetes erecta* (aztec marigold), *Cannabis sativa* (cannabis), *Lantana camara* (lantana), *Mentha piperata* (Pepper mint), *Curcuma longa* (turmeric), *Zingiber officinale* (ginger) and *Allium cepa* (onion) were evaluated for their efficacy against storage rot fungi, germination percentage and seedling vigour of pea. All the plant extracts significantly reduced the storage rot fungi, i.e. *Aspergillus* sp., *Alternaria alternata*, *A. solani*, *Phoma* sp and *Fusarium* spp.; increased seed germination and seedling vigour index of pea. *Vitex negundo* and *Melia azadirachta* found equally effective with minimum storage rot of 1.94%, while the maximum storage rot was observed in control (13.84%) where no seed treatment was done. Maximum seed germination (89.08%) was found in the seed stored in cloth bags, while in plastic bags seed germination found was 88.40 per cent. Maximum germination (96.41%) was recorded in the seed treated with *Mentha piperata*, followed by the *Tagetes erecta* with 94.08 per cent seed germination. Maximum seedling length and dry matter was observed in *Allium sativum* treated seeds with 28.33 cm and 2.66 g. Maximum (2520) seedling vigour I was observed in *Mentha piperata*, similarly maximum (308) seedling vigour II was recorded in *Mentha piperata*. Minimum (2.37%) population of the mycoflora was obtained in seed treated with the *Curcuma longa* when stored in plastic boxes. Lowest (3.28%) mycoflora was observed in *Vitex negundo* treated seed when stored in cloth bags. *Aspergillus* sp. is the most frequently occurring fungi in storage of pea. Pea seeds developed less attack by storage fungi particularly with *Alternaria alternata* and *A. solani* while more association of *Aspergillus* spp., *Phoma* sp. and *Fusarium* spp. were observed with the seeds during storage period in different containers. However fewer microflora (16.40%) developed in cloth bags compared to plastic boxes (20.56%).

Key words: Pea, Plant extract, Storage fungi, Mycoflora, Germination per cent

Garden pea (*Pisum sativum* L.) is one of the most important cool season vegetable crops grown throughout the world. It occupies a position of considerable worth because of its importance in agricultural economy of the country. Ethiopia is probably the main centre of origin of the garden pea. It is very palatable and nutritious for human consumption and is taken fresh, canned, frozen or in dehydrated form. It contains higher proportion of digestible proteins along with carbohydrates, phosphorus, iron, calcium, vitamins A and B (Watt and Merrill 1963 and Hassan 1997). Green tender foliage of garden pea is also used as vegetable in parts of Asia and Africa. Leaves are used as a pot herb in Myanmar and parts of Africa. Garden pea is a cool season crop and is mainly grown in Uttar Pradesh, Bihar, Haryana, Himachal Pradesh and Punjab. However, Uttar Pradesh accounts for 70 per cent of the total out put of peas in India. In Himachal Pradesh, the districts of Lahaul and Spiti, Kinnaur, Shimla, Kullu and Mandi are the major pea producing areas with an area of 23.67 thousand ha (NHB 2015).

Various factors directly influence seed physiological potential, including storage conditions, which are fundamental for maintaining viability and vigor. This is significantly affected by initial seed physiological quality, seed water content, relative humidity, temperature, action of microorganisms and insects and storage period (Carvalho and Nakagawa 2000). It is well known that seed deterioration is faster and intense in tropical and subtropical regions due to the unfavourable pre- and post-harvest weather conditions (Baudet 2003). The pea seed are attacked by numerous seed rotting fungi if they are not properly stored, i.e. improper moisture level at time of storage, temperature and relative humidity etc. The objectives of this study were to evaluate the behaviour of plant extracts to the pea seed lots during storage under different conditions and verify the efficiency of different procedures for germination and seedling vigour index (Maisuria and Patel 2009, Zhao *et al*. 2016).

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MATERIALS AND METHODS

All the laboratory experiments were conducted during 2011-2014, at vegetable and ornamental laboratory, Department of Plant Pathology, Dr Y S Parmar University of Horticulture and Forestry, Nauni, Solan.

Seed treatment: The seeds of Azad P1 cultivar of pea were treated with 30% plant extracts, viz. *Allium sativum, Adhatoda vasica, Vitex negundo*, *Melia azadirachta*, *Tagetes erecta*, *Cannabis sativa*, *Lantana camara*, *Mentha piperata*, *Curcuma longa*, *Zingiber officinale* and *Allium cepa* and evaluated for their efficacy against storage rot fungi and germination percentage and seedling vigour of peas as a pre-storage treatment of the pea seeds. Much care was taken during mixing to have uniformity in coating and the seeds were air dried under shade for 24h to bring back to its original moisture content and then the sowing was done.

Germination: The experiment was conducted with four replications of 50 seeds each, distributed in paper towel rolls moistened with an amount of water 2.5 times the substrate weight at 20 °C. The test was evaluated 5th and 8th days after sowing, according to the criteria described in the Rules for Seed Testing (Brasil 2009). The percentage germination represented the mean of the four replications for each lot and cultivar.

Seedling length: Four replications of 20 seeds each per lot were used in this experiment. Paper towel rolls were moistened with a quantity of water 2.5 times the substrate weight and kept in a germinator at 20 ºC for 5 days; the length of the normal seedlings was measured in centimeters using a graduated ruler (Nakagawa 1999). The results represented the division of the sum of the lengths by the total number of normal seedlings of each replication, for each lot and cultivar.

Statistical analysis: The data on effect of seed coating on pea germination, dry matter production, seedling vigour index, root and shoot length, frequency of mycoflora and seed rot were taken. The experiment was designed as Completely Randomized Block Design (CRD) with eight replications. Statistical analysis was done with using the standard procedure described by Gomez and Gomez (1986).

RESULTS AND DISCUSSION

The effect of pre-storage treatment of pea seeds with the plant extracts against the storage rot fungi, germination percentage and seedling vigour of pea are presented in Table 1. The data revealed that the high percentage of seed rot due

Table 1 Effect of plant extracts on storage rot (%) and seed deformity (%) in pea at storage

Plant extracts	Storage rot (%)			Pooled Mean	Seed deformities (%)			Pooled Mean
	2011-12	2012-13	2013-14		2011-12	2012-13	2013-14	
Allium sativum (Garlic)	1.00 (1.33)	2.00 (1.70)	3.00 (1.60)	2.00 (1.54)	2.50 (1.86)	3.00 (1.64)	2.00 (1.72)	2.50 (1.74)
Adhatoda vasica (Malabar nut)	2.50 (1.86)	1.50 (1.54)	5.00 (2.20)	3.00 (1.87)	1.50 (1.56)	1.00 (1.33)	1.50 (1.56)	1.33 (1.48)
Vitex negundo (Horseshoe vitex)	1.50 (1.57)	1.00 (1.33)	3.33 (1.78)	1.94 (1.56)	1.50 (1.53)	2.00 (1.75)	1.50 (1.53)	1.67 (1.60)
Melia azadirachta (Chinaberry tree)	1.50 (1.83)	5.00 (2.16)	15.00 (3.85)	1.94 (2.16)	2.50 (1.82)	2.50 (1.83)	2.50 (1.82)	2.50 (1.82)
Tagetes erecta (Aztec marigold)	1.83 (1.60)	2.00 (1.80)	3.17 (1.76)	2.33 (1.72)	1.00 (1.33)	2.50 (1.88)	1.00 (1.33)	1.50 (1.51)
Cannabis sativa (Cannabis)	1.00 (1.44)	4.00 (1.97)	21.83 (4.60)	8.94 (2.67)	1.83 (1.60)	1.00 (1.33)	1.83 (1.60)	1.55 (1.51)
Lantana camera (Lantana)	1.00 (1.33)	1.50 (1.58)	4.33 (2.06)	2.27 (1.66)	1.50 (1.57)	2.00 (1.82)	1.50 (1.57)	1.67 (1.65)
Mentha piperata (Pepper mint)	1.5(1.56)	3.00 (1.54)	4.67 (2.11)	3.07 (1.74)	1.50 (1.56)	2.50 (1.97)	1.50 (1.56)	1.83 (1.70)
Curcuma longa (Turmeric)	1.83 (1.58)	2.50 (1.92)	3.33 (1.63)	2.55 (1.71)	1.50 (1.55)	1.00 (1.33)	1.50 (1.55)	1.33 (1.48)
Zingiber officinale (Ginger)	2.00 (1.73)	7.50 (3.89)	23.00 (4.75)	10.83 (3.46)	1.50 (1.54)	2.50 (1.99)	1.50 (1.54)	1.83 (1.69)
Allium cepa (Onion)	2.00 (1.66)	3.50 (1.87)	6.33 (2.46)	3.94 (1.99)	1.00 (1.36)	1.50 (1.59)	1.00 (1.36)	1.17 (1.44)
Control	4.50 (2.32)	15.00 (3.81)	22.03 (4.77)	13.84 (3.63)	3.00 (1.91)	6.00 (2.10)	4.50 (1.73)	4.50 (1.91)

*The figures in parenthesis are arc sine transformed values. CD (0.05) Treatments= 0.63 ; CV% (coefficient of variation)= 32.10, CD (0.05) Treatments= 0.42; CV% (coefficient of variation)= 39.88

to storage fungi (13.84%) as was recorded in untreated seeds including *Zingiber officinale* (10.83%) and *Cannabis sativa* (8.94%), while the *Vitex negundo* and *Melia azadirachta* found equally effective with lowest (1.94%) percentage of seed rotting. The seed deformity was also high (4.5%) in pea seed in control than seeds treated with various plant extracts. Minimum seed rot was caused when seeds were pre-treated with *Adhatoda vasica*, *Curcuma longa* and *Allium cepa* before their storage which are not statistically significant with each other. Ahmed *et al.* (2013) found the efficacy of different plant extracts while working on rice seed infection.

From the data recorded in the Table 2 showed that seed germination was varied from 81.41 per cent to 96.41 per cent. Maximum seed germination (89.08%) was found in the seed stored in cloth bags, while in plastic bags seed germination found was 88.40 per cent. Maximum germination (96.41%) was recorded in the seed treated with *Mentha piperata,* followed by the *Tagetes erecta* with 94.08 per cent seed germination. Lowest seed germination (81.41%) was observed in the *Adhatoda vasica*, followed by the control (82.41%). El-Dahab *et al.* (2015) found the moringa plant extracts as most efficacious in controlling seed borne fungi and enhanced the seed germination of sorghum seeds. Similarly the effectiveness different plant extracts were reported by Bajalan *et al.* (2013) on velvet flower seed and wheat seeds.

The data of seedling length represented in Table 3 indicated that maximum length (28.33 cm) was observed in *Allium* followed by *Adhatoda vasica* (27.67 cm), *Mentha piperata* (27.00 cm), *Tagetes erecta* (23.50 cm) treated seeds by plant extracts which were statistically at par in their performance as far as seedling length is concerned. However, the lowest seedling length was recorded in control with 15.83 cm. No statistical difference in average growth increase recorded in plastic box and cloth bag.

The dry weight also increased (Table 3) and recorded maximum in *Allium sativum* (2.66 g) and *Curcuma longa* (2.58 g) followed by *Tagetes erecta* (2.41 g) and *Cannabis sativa* (2.41 g) treated seeds than rest of the treatments including control. The lowest dry weight (1.58 g) was obtained in *Vitex negundo*. Maximum average dry weight of seedlings was recorded in treated seeds stored in plastic bags with 2.23 g while average dry weight recorded in cloth bags was 1.82 g. Ziaebrahimi *et al.* (2007) reported the increase in seedling length, fresh and dry weight of wheat seeds treated with eucalyptus leaves extract.

The data presented in Table 4 revealed that the average seedling vigour index –I of different treatments was ranging between 2427 to 2520 and average seedling index II varied between 224 to 308. The average seedling vigour I was high (2520) in seeds treated with the *Mentha piperata*, followed by *Allium sativum* (2478) and *Adhathoda visica* (2427), while the lowest seedling vigor-I was observed in treatment *Cannabis sativa* (1472) followed by the control. The average seedling vigour II was high in treatment with *Mentha piperata* (308) followed by *Allium sativum* (234), while the lowest seedling vigour II was recorded in *Vitex*

Table 2 Effect of plant extracts as pre-storage treatment in pea on percent germination of seeds, stored in different containers

Plant extracts	Germination (%)		Mean
	Plastic bags	Cloth bags	
Allium sativum	90.0 (9.49)	97.0 (9.33)	93.5 (9.41)
Adhatoda vasica	85.50 (9.23)	77.33 (8.78)	81.41 (9.00)
Vitex negundo	88.17 (9.39)	88.67 (9.41)	88.42 (9.40)
Melia azadirachta	87.83 (9.37)	93.00 (9.64)	90.41 (9.50)
Tagetes erecta	92.83(9.63)	95.33 (9.76)	94.08 (9.70)
Cannabis sativa	87.00 (9.32)	86.67(9.31)	86.83 (9.31)
Lantana camara	89.83(9.48)	89.00 (9.43)	89.41 (9.45)
Mentha piperata	95.83 (9.79)	97.00 (9.85)	96.41 (9.73)
Curcuma longa	89.00 (9.43)	88.33(9.39)	88.67(9.41)
Zingiber officinale	84.50 (9.19)	85.33 (9.24)	84.91 (9.20)
Allium cepa	86.83(9.32)	90.00(9.49)	88.41 (9.40)
Control	83.50(9.14)	81.33(9.01)	82.41 (9.07)
Mean	88.40 (9.38)	89.08 (9.41)	88.56 (9.25)

The figures in parenthesis are square root transformed values. CD (0.05) Treatments= 0.15; Containers= 0.12; Treatments × Containers=0.42; CV% (coefficient of variation)= 0.004

Table 3 Effect of plant extracts on seedling length and dry weight of pea seedlings

Plant extracts	Seedling length(cm)		Mean	Dry weight (g)		Mean
	Plastic bags	Cloth bags		Plastic bags	Cloth bags	
Allium sativum	29.33	27.33	28.33	2.97	2.34	2.66
Adhatoda vasica	32.0	23.33	27.67	2.17	1.85	2.01
Vitex negundo	15.0	15.33	15.17	1.68	1.49	1.58
Melia azadirachta	20.0	13.33	16.67	2.12	1.75	1.94
Tagetes erecta	22.0	25.0	23.50	2.92	1.90	2.41
Cannabis sativa	19.0	15.33	17.0	2.24	1.40	2.41
Lantana camara	21.33	18.33	19.83	2.05	1.45	1.82
Mentha piperata	27.67	26.33	27.0	2.53	2.64	1.75
Curcuma longa	21.33	14.0	17.67	2.32	1.99	2.58
Zingiber officinale	18.33	18.0	18.17	2.05	1.74	1.89
Allium cepa (Onion)	15.0	22.0	18.50	2.04	1.69	1.86
Control	14.67	17.0	15.83	1.70	1.54	1.62
Mean	21.31	19.58		2.23	1.82	

CD (0.05) Treatments= 0.23; Containers (C) = 1.73; Treatments × Containers(C) =5.97. CV% (coefficient of variation) = 17.81; CD (0.05) Treatments= 0.06; Containers (C) = 0.17; Treatments × Containers(C) =0.60; CV% (coefficient of variation) = 18.05

Table 4 Effect of plant extracts as pre-storage seed treatment on seedling vigour-I and II in pea, stored at different storage containers

Plant extracts	Seedling vigour-I		Mean	Seedling vigour-II		Mean
	Plastic bags	Cloth bags		Plastic bags	Cloth bags	
Allium sativum	2556 (3.41)	2399 (3.38)	2478 (3.39)	275 (2.44)	194 (2.29)	234 (2.36)
Adhatoda vasica	2638 (3.40)	2216 (3.34)	2427 (3.37)	233 (2.36)	206 (2.31)	219 (2.34)
Vitex negundo	1469 (3.17)	1615 (3.21)	1542 (3.19)	161 (2.20)	117 (2.06)	139 (2.13)
Melia azadirachta	1891 (3.78)	1325 (3.12)	1608 (3.20)	209 (2.31)	139 (2.14)	174 (2.23)
Tagetes erecta	2013 (3.30)	2154 (3.32)	2083 (3.31)	238 (2.37)	166 (2.22)	201 (2.29)
Cannabis sativa	1669 (3.22)	1275 (3.40)	1472 (3.16)	202 (2.30)	191 (2.27)	196 (2.29)
Lantana camara	1820 (3.26)	1615 (3.21)	1718 (3.23)	202 (2.31)	178 (2.24)	190 (2.27)
Mentha piperata	2504 (3.40)	2504 (3.40)	2520 (3.40)	379 (2.56)	236 (2.37)	308 (2.46)
Curcuma longa	211 (3.32)	1462 (3.16)	1787 (3.24)	223 (2.35)	224 (2.34)	224 (2.34)
Zingiber officinale	1692 (3.22)	1653 (3.22)	1672 (3.22)	188 (2.26)	169 (2.29)	178 (2.23)
Allium cepa	1974 (3.29)	1574 (2.19)	1774 (3.24)	197 (2.26)	172 (2.22)	185 (2.26)
Control	1716 (3.23)	1289 (3.11)	1502 (3.17)	145 (2.15)	153 (2.18)	149 (2.17)
Mean	2004 (3.29)	1760 (3.23)		220 (2.33)	179 (2.24)	

CD (0.05) Treatments (PE-seedling vigour-I)= 0.87; Containers (C)= 0.35; Treatments (PE-seedling vigour-I) × Containers (C)=1.22; CV% (coefficient of variation)= 2.28.

(139), followed by control. Highest average seedling vigour I was recorded in treatments stored in plastic bags with 2004, while treatment stored in cloth bags recorded 1760. Highest average seedling vigour II highest (220) in plastic bags stored treatments, while the treatment stored in cloth bags recorded 179. The increased in seedling vigour I and II when seeds were treated with different plant extracts were reported by Debnath *et al*. (2012), Perello *et al.* (2013) and Signaboubo *et al*. (2015).

The overall mycoflora encountered from the treated seeds when stored in plastic bags, indicated that the maximum percentage of fungi (10.33%) found associated with untreated seeds (Table 5). However, the least (2.39%) infection appeared in seeds treated with *Curcuma longa* plant extract followed by *Adhatoda vasica* (2.72%), *Lantana camara* (3.61%) and *Allium sativum* (3.67%). In plastic bags stored seeds highest (4.94%) frequency of *Aspergillus* spp was recorded followed by *Phoma* spp. (4.92%). Lower frequency of the *Fusarium* spp found with 4.11 per cent.

It is clear from the Table 6 that highest (7.00%) frequency of fungi when stored in cloth bags, observed in seed treated with *Zingiber officinale* except the control

Table 5 Mycoflora frequency (%) in pea seeds stored in plastic box after plant extract treatment

Treatment	Plastic box					Mean
	Aspergillus spp.	*Phoma* sp.	*Fusarium* sp.	*Alternaria alternata*	*A.solani*	
Allium sativum (Garlic)	2.67 (1.90)	3.00 (1.96)	1.67 (1.62)	6.00 (2.64)	4.33 (2.23)	3.67 (2.11)
Adhatoda vasica (Malabar nut)	5.33 (2.31)	4.0 (2.17)	2.00 (1.62)	1.00 (1.38)	1.67 (1.58)	2.72 (1.80)
Vitex negundo (Horseshoe vitex)	7.33 (2.80)	2.67 (1.90)	4.00 (2.23)	2.00 (1.72)	5.0 (2.39)	4.06 (2.18)
Melia azadirachta (Chinaberry tree)	4.00 (2.21)	7.0 (2.77)	1.67 (1.61)	5.30 (2.51)	8.0 (2.99)	5.33 (2.45)
Tagetes erecta (Aztec marigold)	2.67 (1.91)	3.33 (2.06)	3.00 (1.99)	5.0 (2.39)	3.36 (2.39)	3.78 (2.13)
Cannabis sativa (Cannabis)	4.33 (2.24)	4.67 (2.36)	2.00 (1.66)	5.33 (2.48)	4.33 (2.94)	5.28 (2.41)
Lantana camara (Lantana)	4.33 (2.29)	3.0 (2.29)	5.33 (1.99)	2.33 (1.75)	3.00 (1.99)	3.61 (2.11)
Mentha piperata (Pepper mint)	5.33 (2.51)	5.67 (2.55)	3.00 (1.97)	6.33 (2.70)	1.67 (1.57)	4.22 (2.21)
Curcuma longa (Turmeric)	1.00 (1.38)	2.67 (1.82)	3.00 (1.96)	2.33 (1.82)	4.00 (2.17)	2.39 (1.77)
Zingiber officinale (Ginger)	7.00 (2.83)	7.33 (2.88)	3.67 (2.13)	3.67 (2.14)	7.67 (2.94)	6.00 (2.61)
Allium cepa (onion)	3.33 (2.06)	3.67 (2.14)	2.67 (1.82)	5.33 (2.47)	6.67 (2.74)	4.50 (2.28)
Control	12.0 (3.59)	12.0 (3.58)	17.33 (4.28)	6.0 (2.63)	1.67 (1.58)	10.33 (3.23)
Mean	4.94 (2.34)	4.92 (2.35)	4.11 (2.12)	4.22 (2.22)	4.31 (2.21)	

CD (0.05) Treatments (PE-seedling vigour-I)=0.33; Containers (C)= 0.25; Treatments (PE-seedling vigour-I) × Containers (C)=0.81; CV% (coefficient of variation)= 22.20.

Table 6 Mycoflora frequency (%) in pea seeds stored in cloth bags after plant extracts treatment

Treatment	Cloth bags					Mean
	Aspergillus spp.	*Phomas* sp.	*Fusarium* sp.	*Alternaria alternata*	*A. solani*	
Allium sativum	3.33 (2.03)	4.67 (2.36)	1.67 (1.58)	3.33 (2.07)	12.0 (3.57)	4.50 (2.22)
Adhatoda vasica	1.00 (1.38)	5.67 (2.52)	2.67 (1.87)	5.67 (2.51)	5.33 (1.58)	3.83 (2.12)
Vitex negundo	1.67 (1.58)	3.67 (2.14)	2.00 (1.73)	3.33 (1.94)	4.00 (2.05)	3.28 (1.95)
Melia azadirachta	3.67 (2.13)	4.33 (2.28)	5.0 (2.38)	4.67 (2.32)	3.67 (2.14)	4.17 (2.23)
Tagetes erecta	5.0 (2.41)	11.0 (3.43)	6.33 (2.70)	3.67 (2.03)	6.33 (2.67)	7.00 (2.75)
Cannabis sativa	15.67 (4.04)	7.67 (2.92)	5.33 (2.46)	4.67 (2.34)	4.67 (2.34)	6.72 (2.63)
Lantana camara	4.33 (2.29)	2.33 (1.73)	7.0 (2.83)	3.67 (2.15)	6.33 (2.67)	4.67 (2.31)
Mentha piperata	6.00 (2.63)	3.33 (2.06)	2.33 (1.73)	4.67 (2.37)	5.00 (2.44)	5.56 (2.19)
Curcuma longa	1.33 (1.49)	7.00 (2.73)	4.33 (2.27)	5.00 (2.40)	4.33 (2.24)	4.17 (2.19)
Zingiber officinale	6.00 (2.64)	6.67 (2.69)	8.33 (3.05)	4.67 (2.37)	6.00 (2.61)	7.00 (2.78)
Allium cepa	14.67 (3.89)	8.00 (2.88)	11.0 (3.44)	11.00 (3.46)	3.00 (1.99)	6.55 (2.61)
Control	5.58 (2.40)	12.67 (3.69)	0.0 (1.0)	0.0 (1.0)	0.0 (1.0)	6.72 (2.39)
Mean	5.58 (2.40)	6.42 (2.62)	4.67 (2.26)	4.23 (2.25)	5.06 (2.25)	

CD (0.05) Treatments (PE-seedling vigour-I)=0.36 Containers (C)= 0.26; Treatments (PE-seedling vigour-I) x Containers (C)=0.88; CV% (coefficient of variation)= 22.92

Table 7 Species frequency (%) and storage container effect after plant extract treatment on pea seeds

Species	% frequency (Storage containers)		Mean
	Plastic boxes	Cloth bags	
Aspergillus spp.	18.55	21.42	19.99
Phoma sp.	22.62	13.75	18.19
Fusarium spp	14.44	18.79	16.62
Alternaria alternata	9.68	14.80	12.24
A. solani	10.18	13.25	11.72
Mean	28.56	16.40	

CD 0.05=Species =2.43; Containers=1.95; Interaction (Species × Containers) =5.45

(6.72%). The lowest frequency of the fungi was recorded in seed treated with *Vitex negundo* (3.20%). The highest (6.42%) frequency of the fungi *Phoma* spp. was recorded, while the lowest (4.23%) frequency of fungi *Alternaria alternata* was recorded, when treated seeds were stored in cloth bags. Even in interaction studies of plant extract, storage containers and species occurrence, similar results were obtained. Botanicals have superiority over the control treatment in suppressing the mycoflora. It is evident from above Table 5 and Table 6, that out of five frequently appearing fungi, *Phoma* spp., *Aspergillus* spp. and *Fusarium* spp. were most predominant followed by *Alternaria alternata* and *Alternaria solani* with 9.46, 9.19, 8.44, 8.06 and 6.44 per cent of their occurrence during storage of the seeds in plastic boxes as well as cloth bags. In general, the minimum frequency of mycoflora (%) was recorded in all the treatments of plant extract irrespective of storage containers ranging between 4.17 to 8.53% than untreated seeds with 31.07 percent mycoflora frequency. *Aspergillus* sp. is the most frequently occurring fungi in storage of pea similar results were also reported by Nascimento and Cicero (1991).

The data presented in the Table 7 showed that treated pea seeds developed less attack by storage fungi particularly with *Alternaria alternata* (11.72%) and *A. solani* (12.24%), while more association of *Aspergillus* spp. (19.99%), *Phoma* sp. (18.19%) and *Fusarium* spp. (16.62%) were observed with the seeds during storage period in different containers. However lesser microflora (16.40%) developed in treated seeds stored in cloth bags compared to plastic bags (28.56%). Pea seeds developed less attack by storage fungi particularly with *Alternaria alternata* and *A.solani* while more association of *Aspergillus* spp., *Phoma* sp. and *Fusarium* spp. were observed with the seeds during storage period in different containers (Gupta *et al.* 1984, Sontakke and Hedawoo 2014, Adongo *et al.* 2015, Saxena *et al.* 2015).

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