Plant Archives Vol. 19 No. 1, 2019 pp. 613-617 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

FLOWERING AND FRUITING BEHAVIOR OF SOME EXOTIC OLIVE (*OLEA EUROPAEA* L.) CULTIVARS IN FOOTHILLS OF HIMALAYAS

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Abstract

Seven exotic cultivars viz. Leccino, Messinese, Picholina, Etnea, Itrana, Coratina and Zaituna, grown in the intermediate agro-climatic zone of Jammu province of the Jammu and Kashmir state were evaluated for vegetative, flowering and fruit characteristics. Highest mean rate of shoot development and leaf appearance was observed in the Picholina cultivar and the least in cultivar Leccino during both the cropping years. Emergence of first inflorescence and first flower opening during both the cropping years was earliest in the cultivar Messinese and the latest in cultivar Zaituna. Earliest full bloom was recorded in the cultivar Messinese. The mean number of flowers per inflorescence was maximum in the cultivar Picholina and minimum in the cultivar Coratina. Perfect flower percentage was maximum in the cultivar Messinese (11.02%). Earliest fruit set was recorded in the cultivar Itrana. Maximum fruit length (29.35 mm) was recorded in cultivar Zaituna. Maximum fruit width was recorded in the cultivar Itrana (22.47 mm). Pulp: stone ratio showed significant variations among different olive cultivars. Maximum fresh weight of the olive fruit was recorded in the cultivar Messinese (7.98g). Maximum dry weight was recorded in the cultivar Messinese (3.08g).

Key words : Olive, *Olea europaea*, cultivar, fruit, inflorescence, perfect flower

Introduction

Olive (*Olea europaea* L.) holds an important place in agricultural production as it plays a major role in the economy of many countries. It also increases the land value especially in unsuitable soil for other fruit crops due to its capability to grow under several conditions. It aids in soil conservation, helps to combat problems of environment and its protection that are currently of concern to nations, authorities and international organizations. Olive exhibits a high tendency toward alternate fruit production. Being an industry-dependent commodity, the economic impact of biennial bearing, particularly in oil olives, is highly significant (Lavee, 2006). Alternate bearing is the outcome of various factors like flower bud differentiation, percent fruit set, fruit retention, abscission and fruit growth (Goldschmidt, 2005). The syndrome is first expressed by the intensity of the bloom; there is hardly any flowering in the next season following a heavily loaded On-year and on the contrary, an off year is succeeded by profuse flowering (Goldschmidt, 2005). Olive shoots often grow throughout the year, so that the buds developing in the leaf axils along the shoot are of diverse ages, some emerging after the pit hardening. However, all the buds on the well-lignified parts of the shoot can potentially differentiate to form inflorescence. Due to its varied adaptability to different growing conditions, olive tree is considered as an important crop therefore, can be taken up as an alternative means of sustainable agriculture in rain-fed hills of Jammu region.

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Materials and Methods

The present study was carried out under Horticulture Technology Mission project on seven olive cultivars namely, Leccino, Messinese, Picholina, Etnea, Itrana, Coratina and Zaituna grown in the olive orchard at farm of Department of Horticulture, Govindpura, Ramban, Jammu. The selected trees were uniform in vigour, size

and normal growth and received uniform horticultural practices during the years under observation. The common practices included pruning in December followed by application of recommended doses of Farm Yard Manure and chemical fertilizers (Urea, DAP and MOP). Spray of monocrotophos was done uniformly before emergence of inflorescence and at the time of pit hardening of the olive fruit. Borax was sprayed 20 days after the emergence of inflorescence for better fruit set and retention (Tiku *et al*., 2010). The orchard soil was analyzed for physical and chemical properties and is presented in the table 1. Characterization of olive cultivars was done using different vegetative and yield parameters. For determining mean rate of shoot development ($x10^{-2}$ cm day^{-1}) and mean rate of leaf appearance ($x\ 10^{-1} day^{-1}$), the new shoots emerging during the growth cycles were tagged with four shoots on each tree (north-south and east-west directions) respectively, in each cultivar. Initiation of blooming (emergence of first inflorescence), first flower opening, full bloom (90% anthesis) and number of blooming days were recorded for the seven olive cultivars under study The cultivars were carefully examined for flowering behavior all over the canopy of the tree. Total number of flowers per inflorescence was calculated for each cultivar by counting the average no. of flowers on each inflorescence. Inflorescence samples were collected from each olive cultivar under study for estimating the percentage of the perfect flowers per inflorescence at the time of full bloom (90% anthesis). The perfect flower percentage was calculated using the following equation:

$$\text{Perfect flower (\%)} = \frac{\text{Number of perfect flowers}}{\text{Number of total flowers}} \times 100$$

Olive cultivars were carefully observed for first fruit set for each cultivar and also the percentage of fruit set for each olive cultivar. Current season shoots were selected (replicate) and tagged randomly during the full bloom. First count of the fruitlets was done after 18 days and final fruits were counted at 55 days after full bloom for each cultivar. Average fruit size (length and width) was recorded using a digital vernier caliper during both the cropping seasons. Fruit weight of different olive cultivars was recorded by averaging the weight of five olive fruits of specific cultivars under study. Pulp: stone ratio was worked out by peeling the pulp completely from the stone of the olive fruits. A total of seven treatments (cultivars) were considered in three replicates and the parameters were analyzed using Randomized Block Design (Gomez and Gomez, 1983).

Results and Discussion

Shoot data revealed that different cultivars showed significant variations in the mean rate of shoot development (table 2). The highest mean rate of shoot development (8.54×10^{-2} cm day^{-1}) and mean rate of leaf appearance (2×10^{-1} leaf day^{-1}) was recorded with the cultivar Picholina which was significantly different to other olive cultivars and the lowest mean rate of shoot development (6.18×10^{-2} cm day^{-1}) and mean rate of leaf appearance (1.35×10^{-1} leaf day^{-1}) was observed with the cultivar Leccino. Because all the cultivars received similar cultural practices and inputs, so the variation among the studied cultivars for shoot development and leaf emergence was evidently due to the variation in the genetic background of the cultivars.

Data recorded for the emergence of first inflorescence, first flower, full bloom and number of blooming days for seven cultivars of olive under observation is presented in table 3. The data on emergence of first inflorescence revealed that during the year 2010, first emergence of inflorescence was observed in the cultivar Messinese on 23rd Feb., 2010 and was delayed to 26th March, 2011 in the cultivar Picholina. Similarly, first flower opening was observed in the cultivar Messinese on 19th March, 2010 and lastly it was observed in the cultivar Etnea on 23rd April, 2011. The average number of blooming days was calculated as per days taken from first flower opening to full bloom (90%). The minimum number of blooming days was observed in the cultivars Messinese and Picholina (9 days) and the maximum number of blooming days was observed in the varieties Leccino and Zaituna (14 days) during the first year of study. In the second year of study, cultivar Leccino recorded the maximum number of blooming days (14 days) whereas cultivars Picholina, Etnea and Zaituna recorded minimum number of blooming days (11 days each). The variations in the blooming dates and period among the olive cultivars under study may be attributed to the chilling requirements and variation in genotype of different olive cultivars. The results similar to these were obtained by Abo-El-Ez and Hassnein (2009) and Hassan (2000) who reported that variation in the blooming dates among olive cultivars was due to the genetic background of the trees.

The average number of flowers per inflorescence (table 4) differed in the cultivars ranging from 7.47 (Itrana) to 11.2 (Picholina) and the overall mean number of flowers ranged from 8.11 (Coratina) to 10.54 (Picholina). The perfect flower percentage data presented in the table 4 also shows significant variations among different olive

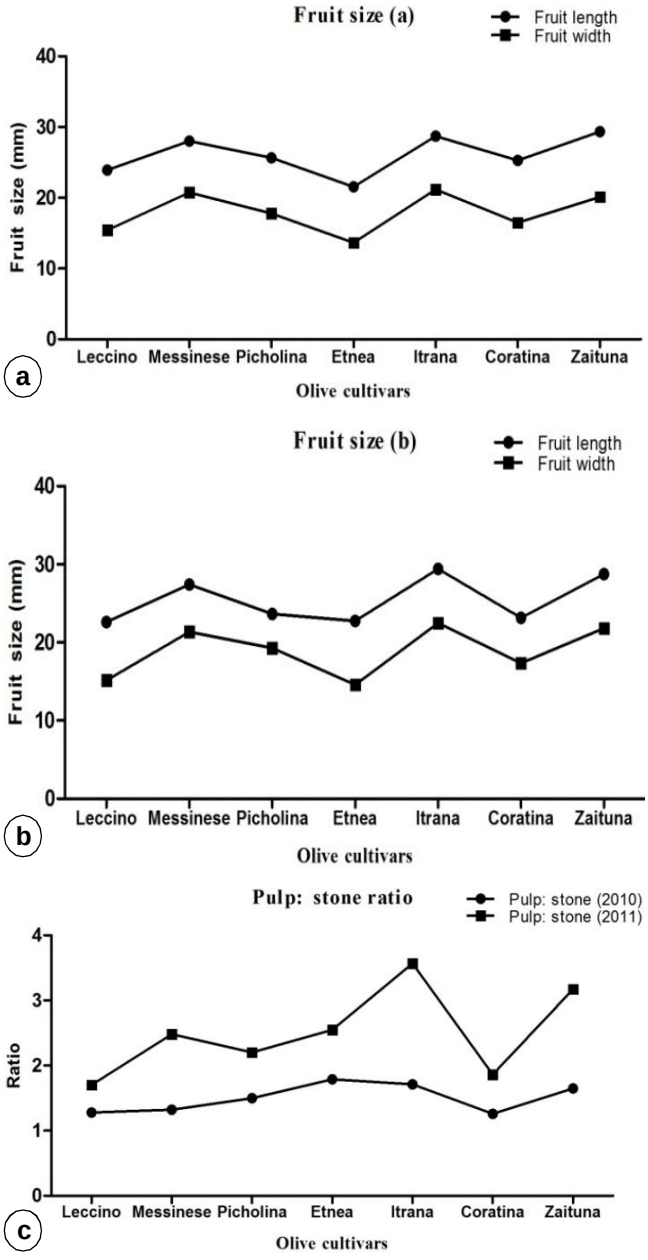

Fig. 1 : Fruit size (a) 2010 (b) 2011 and pulp: stone ratio (c) in different cultivars of olive.

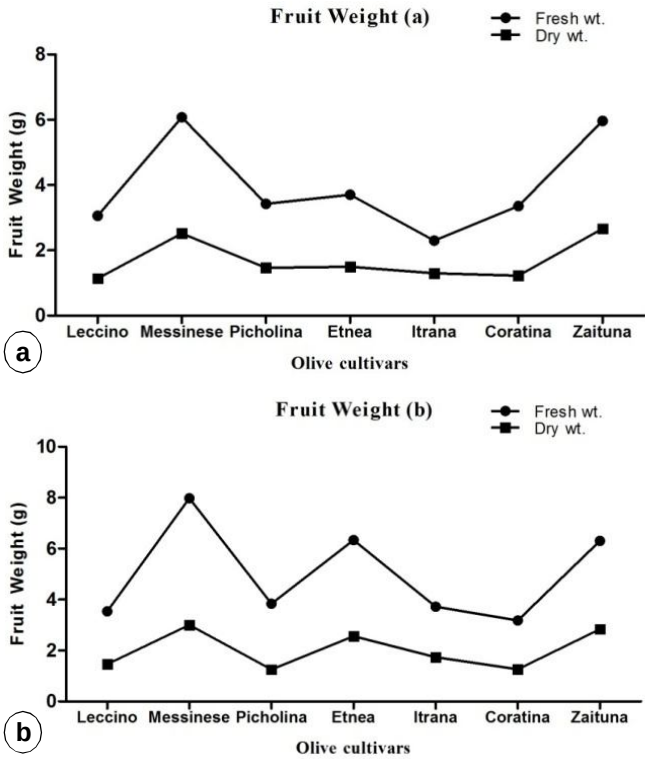

Fig. 2 : Average fresh and dry fruit weight (g) of different cultivars of olive (a) 2010 & (b) 2011.

Table 1 : Physicochemical properties of soil of experimental orchard.

Parameter	Soil layer		
	L-1 (0-15 cm)	L-2 (15-30 cm)	L-3 (30-45 cm)
pH	6.55	6.18	6.60
OC (%)	0.36	0.39	0.52
EC (d Sm^{-1})	0.47	0.64	0.58
N (kg/ha^{-1})	210	225	315
P (kg/ha^{-1})	8.02	8.10	10.92
K (kg/ha^{-1})	142	313	370

cultivars. The maximum percentage of perfect flowers was observed in the cultivar Messinese (11.02%) and the minimum percentage of perfect flowers was recorded in the cultivar Picholina (6.62%). Earliest fruit set in the cultivars was observed on 4th April (Itrana) and the last to set fruit was cultivar Etnea (8th May) (table 4). The variation in the perfect flower percentage of different olive cultivars may be attributed to several factors like prevalent weather conditions, nutrient status of the tree, effect of previous bearing, individual cultivar characteristics or may be due to alternate bearing habit of the olive tree. The fruit set percentage also varied among different olive cultivars. Cultivar Coratina recorded a maximum fruit set percentage of 17.13 percent whereas minimum fruit set percent (7.75%) was recorded in the cultivar Messinese. The presence of higher percentage of perfect flowers is an advantage for higher fruit set and consequently fruit retention or yield. Higher percentage of fruit set can be attributed to the initial high percentage of perfect flowers during (Abo-El-Ez and Hassnein, 2009).

Data recorded on fruit size (length and width) for seven cultivars of olive is presented in fig. 1(a) and (b). The data for fruit length and width revealed that maximum mean fruit length was recorded in the cultivar Zaituna (29.35 mm) and minimum fruit length was recorded in

Table 2 : Mean rate of shoot development in olive cultivars.

Cultivar	Mean rate of shoot development (x 10^{-2} cm day^{-1})			Mean rate of leaf appearance (x 10^{-1} leaf day^{-1})		
	2010	2011	Mean	2010	2011	Mean
Leccino	6	6.36	6.18	1.20	1.5	1.35
Messinese	8.23	8.18	8.20	1.9	1.8	1.85
Picholina	8.45	8.63	8.54	2.06	1.94	2
Etnea	8.13	8.49	8.31	1.95	1.82	1.88
Itrana	7.82	7.53	7.67	2.07	1.92	1.99
Coratina	6.67	6.80	6.73	1.38	1.64	1.51
Zaituna	7.62	7.42	7.52	1.85	1.65	1.75
CD at 5%	0.48	0.04		0.19	0.05	

Table 3 : Emergence of first inflorescence, first flower opening and full bloom and number of blooming days in different cultivars of olive.

Cultivar	Emergence of first inflorescence		First flower opening		Full Bloom (90%)		Blooming Days	
	2010	2011	2010	2011	2010	2011	2010	2011
Leccino	28/2	23/3	23/3	13/4	6/4	27/4	14	14
Messinese	23/2	19/3	19/3	18/4	28/3	30/4	9	12
Picholina	25/2	26/3	22/3	19/4	31/3	30/4	9	11
Etnea	28/2	23/3	29/3	23/4	10/4	4/5	12	11
Itrana	25/2	21/3	22/3	15/4	1/4	28/4	10	13
Coratina	24/2	15/3	21/3	18/4	2/4	01/5	12	13
Zaituna	01/3	21/3	28/3	19/4	11/4	30/4	14	11
CD at 5%							1.25	NS

Table 4 : Percentage of perfect flowers, number of flowers per inflorescence and fruit set in different cultivars of olive.

Cultivar	No. of flowers per inflorescence			Percentage of perfect flowers			Fruit set		Fruit set (%)		
	2010	2011	Mean	2010	2011	Mean	2010	2011	2010	2011	Mean
Leccino	8.45	8.50	8.47	8.20	10.95	9.57	13/4	3/5	12.78	13.61	13.20
Messinese	10.32	7.52	8.92	9.10	12.94	11.02	6/4	7/5	7.75	10.89	9.32
Picholina	9.88	11.2	10.54	5.05	8.19	6.62	8/4	5/5	9.59	9.43	9.51
Etnea	9.30	7.77	8.53	9.09	11.86	10.47	15/4	8/5	14.87	13.74	14.31
Itrana	11.14	7.47	9.30	7.69	8.97	8.33	4/4	2/5	10.86	13.77	12.32
Coratina	7.52	8.71	8.11	7.83	7.81	7.82	10/4	7/5	10.56	17.13	13.85
Zaituna	10.33	8.5	9.41	8.60	8.92	8.76	13/4	4/5	15	15.29	15.15
CD at 5%	0.07	0.30		0.05	0.04				0.14	0.14	

the cultivar Etnea (21.56 mm). The fruit width also varied among the different olive cultivars. Maximum fruit width was recorded in the cultivar Itrana (22.47 mm) whereas minimum fruit width was recorded in the cultivar Etnea (13.65 mm). The pulp: stone ratio of the fruit also varied considerably among the cultivars (Fig: 1c). Maximum pulp: stone ratio was recorded in the cultivar Itrana (3.57) and minimum pulp: stone ratio was recorded in the cultivar Coratina (1.26).

There were significant differences in the mean fresh and dry weights of the olive fruit samples of the olive cultivars (figs. 2 a & b). Maximum fresh weight of the olive fruit was observed in the cultivar Messinese (7.98 g) and the minimum fresh weight was recorded in the cultivar Coratina (3.18 g). The dry weight of the olive fruit also varied significantly among the different olive cultivars. The maximum dry weight of the olive fruit was recorded with the cultivar Messinese (3.0 g) and the minimum dry weight of the olive fruit was recorded with the cultivar Picholina (1.25 g). The difference in the respective weights of fruits of different olive cultivars was due to the genetic background of the cultivars under

the study. The results are in agreement with the works of Abo-El-Ez and A.M. Hassnein (2009), who reported a positive correlation between the fruit size and fruit weight of the olive fruits of different olive cultivars. Fruit size is also affected by a number of variables, including source-sink relationship (Proietti *et al*, 2006 and Rosati *et al*, 2010).

Conclusion

All the cultivars of olive under the study had significant variations in their growth, flowering and fruiting behavior. The present study dealing with the aspects of floral biology will go a long way for improvement of olive in formulating the breeding programme for olive in the intermediate agro-climatic zone of Jammu province in the state of Jammu and Kashmir.

Acknowledgement

The financial support provided during the course of the Horticulture Technology Mission project on olive (2.41) at Division of Biochemistry and Plant Physiology, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu is duly acknowledged.

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