ISAH-INDIAN JOURNAL OF ARID HORTICULTURE
2019, Vol. 1(2):24-30

Yield and economics of pomegranate as influenced by flower regulation under hot arid climate

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(Received: 02.06.2020; Accepted: 10.07.2020)

Abstract

The present study was carried out to improve the marketable yield of pomegranate by flower regulation through withholding of irrigation at different time, pruning and ethrel application. Pooled data revealed that horticultural interventions, chemical applications and their interactions significantly affected total fruit yield, marketable fruit yield, gross return, net return and B:C ratio of pomegranate under hot arid climate. Among horticultural interventions, significantly highest marketable fruit yield, net return and B:C ratio (9.27 t/ha, 194881 Rs./ha and 2.34) were registered in withholding of irrigation during June + pruning and thinning as against minimum recorded in control *i.e.* natural flowering (7.32 t/ha, 138553 Rs./ha and 1.70), respectively. Among chemical applications, significantly highest marketable fruit yield, net return, B:C ratio (9.52 t/ha, 202268 Rs./ha and 2.42) were registered in application of ethrel 2 ml/l + DAP 5 g/l as compared to control without chemicals. Among interactions, significantly highest marketable fruit yield, net return and B:C ratio (10.90 t/ha, 242627 Rs./ha and 2.87) were registered in treatment withholding of irrigation during June + pruning and thinning + ethrel 2 ml/l + DAP 5 g/l treatment as compared to minimum recorded in absolute control treatment *i.e.* natural flowering without chemicals (6.64 t/ha, 121644 Rs./ha and 1.57), respectively. In conclusion, withholding of irrigation during June + pruning and thinning + ethrel 2 ml/l + DAP 5 g/l treatment combination was found significantly superior over other treatments with highest marketable yield, net return and B:C ratio under hot arid climate.

Key words: Ethrel, flower regulation, marketable yield, net return, water stress

Introduction

Pomegranate (*Punica granatum* L.) is an emerging fruit crop of hot arid regions originated from Iran. In India, pomegranate is cultivated on large scale in the states of Maharashtra, Gujarat, Karnataka, Andhra Pradesh, Tamil Nadu, Madhya Pradesh and Rajasthan. India is one of the largest producers of pomegranate in the world. During 2018-19, pomegranate was grown over 2.62 lakh ha area with an annual production of 30.34 lakh tonnes and a productivity of 11.58 tonnes/ha in India (Anonymous, 2019). In India, pomegranate is available throughout the year from January to December owing to varied climatic conditions. Maharashtra is the major pomegranate growing state covering 63.23% of the total area and 62.90% of total production followed by Gujarat with 13.04% area and 16.23% production; and Karnataka with 11.10% area and 9.42% production (Anonymous, 2018). Pomegranate has ability to tolerate abiotic stresses *i.e.* heat, drought and saline conditions prevailing in hot arid regions. The area under pomegranate cultivation in hot arid region is increasing continuously owing to its high demand, hardy nature, better storage quality and nutritional value. It has enormous medicinal, therapeutic values and one of the richest sources of antioxidants. A large number of value added products are developed by processing the fruit such as juices, squash, jelly, wine, seed oil, mouth freshener, *etc.* In Rajasthan, it is commercially grown in Jaipur, Ajmer, Alwar, Tonk, Sri Ganganagar, Pali, Kota, Jalore, Barmer, Jodhpur, Jaisalmer, Sawai Madhopur, Bhilwara, Jhunjhunu and Sirohi districts over 12,000 ha area and acreage in Thar desert particularly Barmer, Jodhpur and Jaisalmer is increasing at faster rate. Under arid and semi-arid regions, about 25-60% fruit cracking has been reported during maturity in different bahars which varies with variety, season and climate. The cracked fruits are sweeter with low shelf life; highly liable to fruit rot and are unsuitable for transport (Saroj and Kumar, 2019). Pomegranate flowers continuously under hot arid climatic conditions and bear small crop irregularly at different period of the year, which may not be desirable commercially. To avoid this, plants are subjected to flower regulation/bahar treatment. In this treatment, the irrigation is withheld one to two months prior to the bahar followed by light earthing up in the basin. This facilitates the shedding of leaves, induction of profuse flowering and fruiting. The availability of irrigation water/rainfall, climatic condition, insect-pests, diseases, and market demand are major considerations for flower regulation (Kumar *et al.*, 2018a). Moisture stress, plant bio-regulators, defoliants, nutrient and canopy management including training, pruning and thinning are major horticultural interventions that influence flowering and fruit quality in pomegranate (Kumar *et al.*, 2019a). Water stresses trigger a

wide variety of plant responses, ranging from altered gene expression and cellular metabolism to changes in plant growth, leaf morphology and movement and root development and finally productivity (Kumar *et al.*, 2019b). In pomegranate cultivation, economics or net return mainly depends on marketable yield and fruit quality. Fruit cracking is major problem under hot arid climate which deteriorate fruit quality and reduce marketable yield. Therefore, the present study was conducted to induce flowering by withholding of irrigation, pruning and ethrel application in desired period to produce improved quality and higher yield with minimum incidence of fruit cracking.

Materials and Methods

The present investigation was carried out during two consecutive years 2017-18 and 2018-19 at ICAR-Central Institute for Arid Horticulture, Bikaner. The experiment was conducted in Factorial Randomized Block Design with three replications comprising 20 treatment combinations. There were two factors *i.e.* horticulture interventions and chemical applications. The horticulture interventions (P) have five levels *i.e.* P_0-control natural flowering, P_1-withholding of irrigation during March, P_2-withholding of irrigation during March + pruning and thinning, P_3- withholding of irrigation during June and P_4- withholding of irrigation during June + pruning and thinning; while chemical applications (C) have four levels *i.e.* C_0-control without chemicals, C_1-ethrel 1 ml/l + DAP 5 g/l, C_2-ethrel 2 ml/l + DAP 5 g/l and C_3-ethrel 3 ml/l + DAP 5 g/l. Pruning of 20 cm growth was carried out after withholding of irrigation period. In thinning, flowers were removed manually before and during water stress period and only flowers produced after flower treatment were retained and allowed to set fruits. Ethrel (40%) and DAP (18:46 grade) were applied as foliar spray after withholding of irrigation period and pruning, while in control (P_0) treatments, chemicals were applied in last week of May. The experiment was conducted on eight years old orchard of pomegranate cv. Jalore Seedless planted at 5x2.5 m^2 spacing under drip irrigation. The soil of pomegranate orchard was loamy sand with pH of 8.32 and electrical conductivity of 0.27 dSm^{-1}. It had 0.15% organic carbon, 106.4 kg/ha available nitrogen, 11.51 kg/ha available phosphorus and 214.5 kg/ha available potassium content. Data were recorded on yield and economic attributes *viz.*, total fruit yield, marketable fruit yield, gross return, net return and B:C ratio. The data were analyzed statistically as per the methods suggested by Gomez and Gomez (1984).

Results and Discussion

The perusal of data presented in Table 1 divulged that horticultural interventions, chemical applications and their interaction significantly improved total fruit yield of pomegranate. Among different horticultural interventions, during 2017-18 and pooled basis, significantly maximum total fruit yield (10.72 and 10.67 t/ha) was recorded in withholding of irrigation during June (P_3) treatment which was followed by total fruit yield (10.24 and 10.60 t/ha) in withholding of irrigation during June + pruning and thinning (P_4) treatment, respectively. During 2018-19, significantly maximum fruit yield (10.96 t/ha) was recorded in withholding of irrigation during June + pruning and thinning (P_4) treatment which was statistically at par with withholding of irrigation during June (P_3) treatment (10.61 t/ha). The minimum fruit yield (9.30, 9.41 and 9.35 t/ha) was recorded in control natural flowering (P_0) treatment in the years 2017-18, 2018-19 and pooled basis, correspondingly.

Among different chemical applications, significantly maximum total fruit yield (10.90, 11.39 and 11.15 t/ha) was recorded in application of ethrel 2 ml/l + DAP 5 g/l (C_2) treatment which was followed by ethrel 1 ml/l + DAP 5 g/l (C_1) treatment (10.22, 10.66 and 10.44 t/ha) as against minimum fruit yield recorded in control without chemicals (C_0) treatment (9.22, 9.21 and 9.22 t/ha) in the years 2017-18, 2018-19 and pooled basis, respectively. Among interaction treatments, maximum total fruit yield (11.89, 12.92 and 12.40 t/ha) was recorded in withholding of irrigation during June + pruning and thinning + ethrel 2 ml/l + DAP 5 g/l (P_4C_2) treatment which was followed by withholding of irrigation during June + ethrel 2 ml/l + DAP 5 g/l (P_3C_2) treatment (11.69, 11.88 and 11.79 t/ha) in the years 2017-18, 2018-19 and pooled basis, respectively. The minimum fruit yield (8.56, 8.57 and 8.57 t/ha) was recorded in absolute control *i.e.* control natural flowering without chemical (P_0C_0) treatment in the years 2017-18, 2018-19 and pooled basis, respectively.

The higher total fruit yield in withholding of irrigation during June with/without pruning and thinning + ethrel 2 ml/l + DAP 5 g/l treatments might be due to favourable growth condition which improved fruit weight/number while ethrel increased the numbers of bisexual flowers with high fruit set and retention. These results in accordance with Pawar *et al.* (1994), Sheikh and Rao (2002), Ustad (2011) and Chakma (2014) who observed that fruit yield significantly influenced by pruning intensity. Similarly, Goswami *et al.* (2013), Korde (2015), Kumar *et al.* (2018b) reported that application of ethrel improved fruit yield of pomegranate as compared to minimum in control. Murthy (2014) and Supe *et al.* (2015) reported that spraying of ethrel 2 ml/l mixed with DAP 5 g/l and ethrel (2 ml/l) increased fruit yield in pomegranate, respectively.

The perusal of data (Table 2) revealed that horticultural interventions, chemical applications and their interaction significantly improved marketable yield of pomegranate. Among horticultural interventions, during 2017-18, significantly maximum marketable yield (8.99 t/ha) was registered in withholding of irrigation during June + pruning and thinning (P_4) treatment which was followed by withholding of irrigation during March + pruning and thinning (P_2) treatment (8.80 t/ha). During 2018-19 and pooled basis significantly maximum marketable yield (9.56 and 9.27 t/ha) was registered in the withholding of irrigation during June + pruning and thinning (P_4) treatment which was followed by withholding of irrigation during June (P_3) treatment (8.84 and 8.80 t/ha), respectively. The minimum marketable yield (7.61,

Table 1. Effect of flower regulation treatments on yield attributes of pomegranate

Treatment	Total fruit yield (t/ha)			Marketable fruit yield (t/ha)		
	2017-18	2018-19	Pooled	2017-18	2018-19	Pooled
	Horticultural interventions (P)			Horticultural interventions (P)		
P_0	9.30	9.41	9.35	7.61	7.04	7.32
P_1	9.92	10.10	10.01	8.08	7.81	7.94
P_2	9.99	10.29	10.14	8.80	8.01	8.40
P_3	10.72	10.61	10.67	8.77	8.84	8.80
P_4	10.24	10.96	10.60	8.99	9.56	9.27
SEm ±	0.11	0.13	0.09	0.07	0.11	0.07
CD (5 %)	0.31	0.38	0.24	0.20	0.33	0.19
	Chemical applications (C)			Chemical applications (C)		
C_0	9.22	9.21	9.22	7.56	7.09	7.32
C_1	10.22	10.66	10.44	8.62	8.64	8.63
C_2	10.90	11.39	11.15	9.46	9.57	9.52
C_3	9.79	9.83	9.81	8.16	7.70	7.93
SEm ±	0.10	0.12	0.08	0.06	0.10	0.06
CD (5 %)	0.28	0.34	0.21	0.18	0.29	0.17
	Interaction (PxC)			Interaction (PxC)		
P_0C_0	8.56	8.57	8.57	6.88	6.40	6.64
P_0C_1	9.51	9.62	9.57	7.74	7.11	7.42
P_0C_2	9.79	10.10	9.94	8.30	7.97	8.14
P_0C_3	9.33	9.33	9.33	7.5 2	6.66	7.09
P_1C_0	9.30	9.17	9.23	7.29	6.58	6.93
P_1C_1	10.08	10.54	10.31	8.30	8.29	8.29
P_1C_2	10.56	10.87	10.71	9.01	8.90	8.96
P_1C_3	9.75	9.83	9.79	7.73	7.46	7.60
P_2C_0	9.23	9.22	9.22	7.87	6.77	7.32
P_2C_1	10.28	10.88	10.58	9.08	8.65	8.87
P_2C_2	10.60	11.19	10.89	9.65	9.21	9.43
P_2C_3	9.86	9.87	9.86	8.59	7.39	7.99
P_3C_0	9.87	9.55	9.71	7.81	7.60	7.71
P_3C_1	10.84	10.92	10.88	8.76	9.08	8.92
P_3C_2	11.69	11.88	11.79	9.90	10.42	10.16
P_3C_3	10.48	10.10	10.29	8.59	8.25	8.42
P_4C_0	9.14	9.55	9.35	7.94	8.08	8.01
P_4C_1	10. 38	11.36	10.87	9.20	10.08	9.64
P_4C_2	11.89	12.92	12.40	10.44	11.36	10.90
P_4C_3	9.53	10.02	9.77	8.37	8.70	8.54
SEm ±	0.22	0.26	0.17	0.14	0.23	0.13
CD (5 %)	0.62	0.76	0.48	0.39	0.66	0.38

Table 2. Effect of flower regulation treatments on economics of pomegranate

Treatment	Gross return (Rs./ ha)			Net return (Rs./ha)		
	2017-18	2018-19	Pooled	2017-18	2018-19	Pooled
	Horticultural interventions (P)			Horticultural interventions (P)		
P_0	228213	211102	219657	147108	129997	138553
P_1	242419	234277	238348	161117	152975	157046
P_2	263969	240182	252076	180698	156910	168804
P_3	263051	265178	264114	181749	183876	182812
P_4	269651	286654	278153	186379	203383	194881
SEm±	2065	3436	2005	2065	3436	2005
CD (5 %)	5913	9838	5646	5913	9838	5646
	Chemical applications (C)			Chemical applications (C)		
C_0	226734	212565	219649	148296	134126	141211
C_1	258472	259289	258881	177066	177883	177475
C_2	283846	287199	285523	200592	203945	202268
C_3	244789	230861	237825	159687	145759	152723
SEm±	1847	3074	1793	1847	3074	1793
CD (5 %)	5288	8800	5050	5288	8800	5050
	Interaction (PxC)			Interaction (PxC)		
P_0C_0	206265	192008	199137	128773	114515	121644
P_0C_1	232177	213298	222738	151716	132838	142277
P_0C_2	248958	239169	244064	166650	156860	161755
P_0C_3	225450	199934	212692	141293	115777	128535
P_1C_0	218653	197430	208041	140963	119740	130351
P_1C_1	248878	248747	248813	168221	168090	168155
P_1C_2	270372	266996	268684	187866	184490	186178
P_1C_3	231773	223935	227854	147419	139581	143500
P_2C_0	236133	202978	219556	156473	123319	139896
P_2C_1	272421	259620	266021	189794	176992	183393
P_2C_2	289533	276394	282964	205058	191918	198488
P_2C_3	257790	221734	239762	171466	135411	153438
P_3C_0	234438	228131	231284	156748	150441	153595
P_3C_1	262888	272478	267683	182231	191820	187025
P_3C_2	297077	312522	304800	214571	230016	222294
P_3C_3	257799	247579	252689	173445	163225	168335
P_4C_0	238183	242276	240229	158523	162616	160570
P_4C_1	275997	302304	289150	193369	219676	206522
P_4C_2	313291	340915	327103	228816	256439	242627
P_4C_3	251134	261124	256129	164810	174800	169805
SEm±	4130	6873	4009	2417	5047	2798
CD (5 %)	11825	19677	11293	6921	14450	7882

7.04 and 7.32 t/ha) was registered in control natural flowering (P_0) treatment during 2017-18, 2018-19 and pooled basis, respectively. Among different chemical applications, maximum marketable yield (9.46, 9.57 and 9.52 t/ha) was registered in ethrel 2 ml/l + DAP 5 g/l (C_2) treatment followed by marketable yield (8.62, 8.64 and 8.63 t/ha) in ethrel 1 ml/l + DAP 5 g/l (C_1) treatment while minimum marketable yield (7.56, 7.09 and 7.32 t/ha) was registered in control without chemicals (C_0) treatment in the years 2017-18, 2018-19 and pooled basis, respectively. Among interaction treatments, significantly maximum marketable yield (10.44, 11.36 and 10.90 t/ha) was registered in withholding of irrigation during June + pruning and thinning + ethrel 2 ml/l + DAP 5 g/l (P_4C_2) treatment which was followed by marketable yield (9.90, 10.42 and 10.16 t/ha) in withholding of irrigation during June with ethrel 2 ml/l + DAP 5 g/l (P_3C_2) treatment as against

minimum marketable yield (6.88, 6.40 and 6.64 t/ha) was recorded in absolute control (P_0C_0) treatment in the years 2017-18, 2018-19 and pooled basis, respectively.

The higher marketable yield in treatment withholding of irrigation during June + pruning and thinning + ethrel 2 ml/l + DAP 5 g/l (P_4C_2) might be due to favourable growth condition which resulted in higher fruit set and weight, higher photosynthetic efficiency; pruning and thinning encouraged more flow of nutrients and water towards fruits while application of ethrel increased numbers of bisexual flowers which improved fruit set and retention. The cumulative effect of season, pruning, thinning and ethrel application have improved marketable fruit yield and reduced fruit cracking. Similar results were also obtained by Goswami *et al.* (2013) and Kumar *et al.* (2018b) with ethrel application in pomegranate. These findings are in accordance to Pawar *et al.* (1994), Sheikh and Rao (2002) and Ustad (2011) who observed maximum better grade/size fruits in higher pruning intensity. Korde (2015) reported that ethrel application significantly improved fruit size, yield and reduced fruit cracking in pomegranate. Murthy (2014) and Supe *et al.* (2015) reported that ethrel application increased fruit size and thereby increased marketable yield in pomegranate.

The data presented in Table 2 divulged that there was significant effect of horticultural interventions on gross return. During 2017-18, significantly maximum gross return (269651 Rs./ha) was recorded in treatment of withholding of irrigation during June + pruning and thinning (P_4) which was followed by withholding of irrigation during March + pruning and thinning (P_2) treatment (263969 Rs./ha) and withholding of irrigation during June (P_3) treatment (263051 Rs./ha). During 2018-19, and pooled basis significantly maximum gross return (286654 and 278153 Rs./ha) was recorded in treatment withholding of irrigation during June + pruning and thinning (P_4) which was followed by withholding of irrigation during June (P_3) treatment (265178 and 264114 Rs./ha), respectively. The minimum gross return (228213, 211102 and 219657 Rs./ha) was recorded in control natural flowering (P_0) treatment in the years 2017-18, 2018-19 and pooled basis, correspondingly. The gross return was significantly affected by different chemical applications. The maximum gross return (283846, 287199 and 285523 Rs./ha) was recorded in ethrel 2 ml/l + DAP 5 g/l (C_2) treatment which was followed by ethrel 1 ml/l + DAP 5 g/l (C_1) treatment (258472, 259289 and 258881 Rs./ha) as compared to minimum gross return recorded in control without chemicals (C_0) treatment (226734, 212565 and 219649 Rs./ha) in the years 2017-18, 2018-19 and pooled basis, respectively.

The interaction of horticultural interventions (P) and chemical applications (C) was found significant in both the years and also pooled basis. The maximum gross return (313291, 340915 and 327103 Rs./ha) was recorded in treatment withholding of irrigation during June + pruning and thinning + ethrel 2 ml/l + DAP 5 g/l (P_4C_2) which was followed by withholding of irrigation during June with ethrel 2 ml/l + DAP 5 g/l (P_3C_2) treatment (297077, 312522 and 304800 Rs./ha) in the years 2017-18, 2018-19 and pooled basis, respectively. The minimum gross return (206265, 192008 and 199137 Rs./ha) was recorded in absolute control (P_0C_0) treatment in the years 2017-18, 2018-19 and pooled basis, respectively. The combined effect of season, pruning, thinning and ethrel application have improved marketable fruit yield and thereby increased gross return. These results are in accordance with Goswami *et al.* (2013), Korde (2015) and Kumar *et al.* (2018b) with ethrel application in pomegranate. Murthy (2014) and Supe *et al.* (2015) reported that ethrel application increased fruit size and thus increased marketable yield and gross return of pomegranate.

The data presented in Table 2 revealed that there was significant effect of horticultural interventions on net return. Among different horticultural interventions, significantly maximum net return (186379, 203383 and 194881 Rs./ha) was recorded in withholding of irrigation during June + pruning and thinning (P_4) treatment which was followed by withholding of irrigation during June (P_3) treatment (181749, 183876 and 182812 Rs./ha) in the years 2017-18, 2018-19 and pooled basis, respectively. The minimum net return (147108, 129997 and 138553 Rs./ha) was recorded in control natural flowering (P_0) treatment in the years 2017-18, 2018-19 and pooled basis, correspondingly. The net return was significantly affected by different chemical applications. The maximum net return (200592, 203945 and 202268 Rs./ha) was recorded in ethrel 2 ml/l + DAP 5 g/l (C_2) treatment which was followed by ethrel 1 ml/l + DAP 5 g/l (C_1) treatment (177066, 177883 and 177475 Rs./ha) as against minimum net return recorded in control without chemicals (C_0) treatment (148296, 134126 and 141211 Rs./ha) in the years 2017-18, 2018-19 and pooled basis, respectively. The data divulged that interaction of horticultural interventions (P) and chemical treatments (C) was found significant in both the years and pooled basis. The maximum net return (228816, 256439 and 242627 Rs./ha) was recorded in withholding of irrigation during June + pruning and thinning with ethrel 2 ml/l + DAP 5 g/l (P_4C_2) treatment which was followed by withholding of irrigation during June with ethrel 2 ml/l + DAP 5 g/l (P_3C_2) treatment (214571, 230016 and 222294 Rs./ha) in the years 2017-18, 2018-19 and pooled basis, respectively. The minimum net return was recorded (128773, 114515 and 121644 Rs./ha) in absolute control (P_0C_0) treatment in the years 2017-18, 2018-19 and pooled basis, respectively. In pomegranate cultivation, fruit yield, quality and cost of cultivation are major factors which determine net returns. Higher net return in treatment withholding of irrigation during June + pruning and thinning + ethrel 2 ml/l + DAP 5 g/l (P_4C_2) might be due to higher yield, improved fruit quality with minimum fruit cracking incidence caused by the cumulative effect of season, pruning, thinning and ethrel application. These results are in close conformity with Goswami *et al.* (2013), Murthy (2014), Supe *et al.* (2015) Korde (2015) and Kumar *et al.* (2018b) with ethrel application in pomegranate.

There was significant effect of horticultural interventions on B:C ratio of pomegranate (Fig. 1). Among

different horticultural interventions, significantly maximum B:C ratio (2.25, 2.44 and 2.34) was recorded in withholding of irrigation during June + pruning and thinning (P_4) treatment which was followed by withholding of irrigation during June (P_3) treatment (2.23, 2.26 and 2.25) in the years 2017-18, 2018-19 and pooled basis, respectively. The minimum B:C ratio (1.80, 1.60 and 1.70) was recorded in control (P_0) treatment in the years 2017-18, 2018-19 and pooled basis, respectively. The B:C ratio was significantly affected by different chemical applications. The maximum B:C ratio (2.40, 2.45 and 2.42) was recorded in ethrel 2 ml/l + DAP 5 g/l (C_2) treatment which was followed by ethrel 1 ml/l + DAP 5 g/l (C_1) treatment (2.17, 2.18 and 2.18) in comparison to minimum B:C ratio (1.89, 1.71 and 1.80) recorded in control without chemicals (C_0) treatment in the years 2017-18, 2018-19 and pooled basis, respectively. The interaction of horticultural interventions (P) and chemical applications (C) was found significant in both the years and also pooled basis. The maximum B:C ratio (2.71, 3.04 and 2.87) was registered in withholding of irrigation during June + pruning and thinning with ethrel 2 ml/l + DAP 5 g/l (P_4C_2) treatment which was followed by withholding of irrigation during June with ethrel 2 ml/l +DAP 5 g/l (P_3C_2) treatment (2.60, 2.79 and 2.69) in the years 2017-18, 2018-19 and pooled basis, respectively. During 2017-18, minimum B:C ratio (1.66) was recorded in absolute control (P_0C_0) treatment which was at par with natural flowering with ethrel 3 ml/l +DAP 5 g/l (P_0C_3) treatment (1.68). During 2018-19 and pooled basis, minimum B:C ratio (1.38 and 1.53) was registered in natural flowering with 3 ml/l + DAP 5 g/l (P_0C_3) treatment which was at par with absolute control (P_0C_0) treatment (1.48 and 1.57), respectively. Higher B:C ratio in withholding of irrigation during June + pruning and thinning with ethrel 2 ml/l + DAP 5 g/l (P_4C_2) treatment could be attributed to higher marketable yield and low cost of cultivation. Similarly, Kumar *et al.* (2018b) obtained highest B:C ratio with ethrel application in pomegranate while

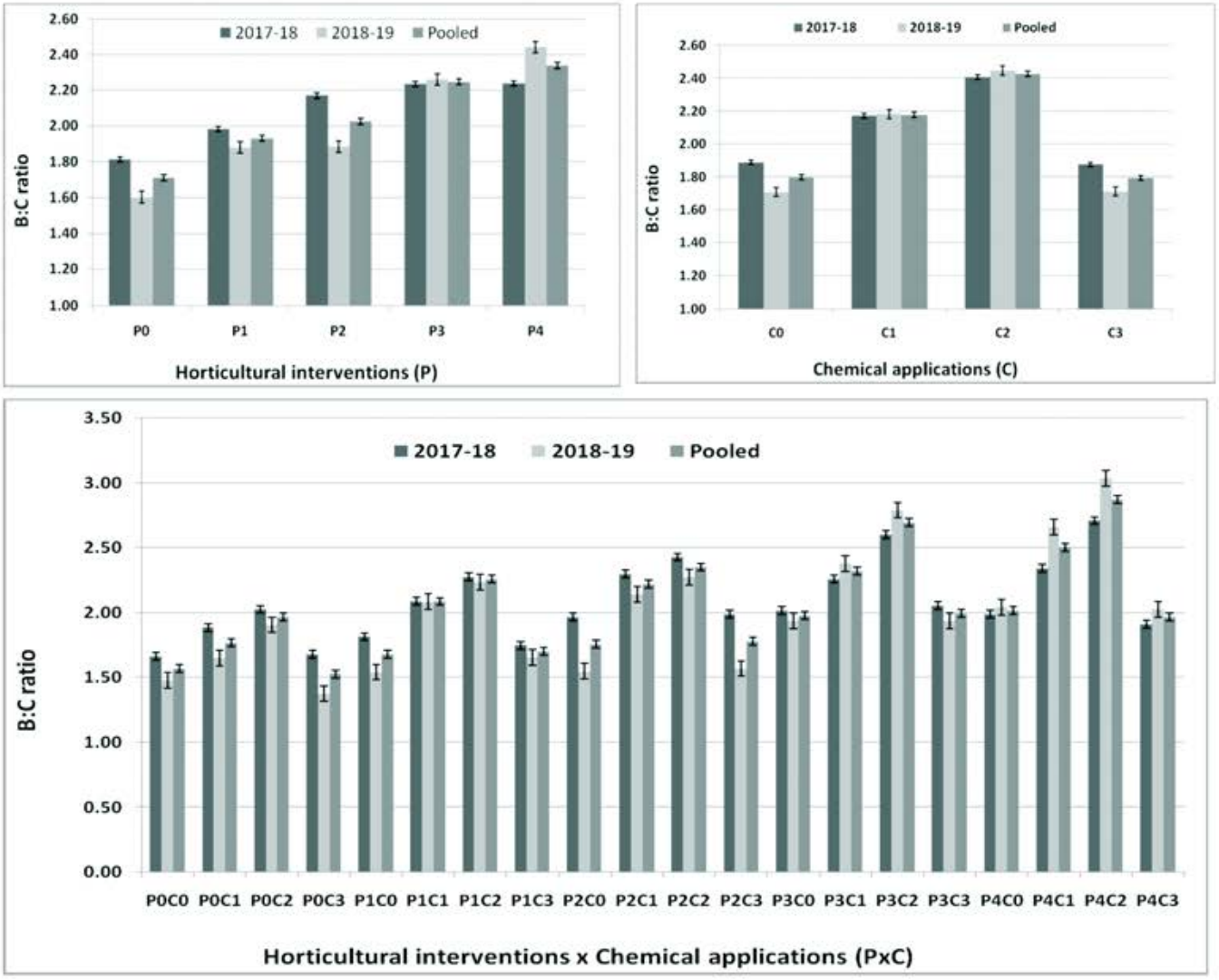

Fig. 1. Effect of flower regulation on benefit cost ratio of pomegranate

Acknowledgements

The authors are grateful to the Swami Keshwanand Rajasthan Agricultural University, Bikaner and ICAR–Central Institute for Arid Horticulture, Bikaner for providing necessary guidance, field and laboratory facilities to conduct the research.

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