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Research Article

Effect of Sowing Date and Seed Pelleting on Plant Growth, Yield and Quality of Onion (*Allium cepa* L.)

Abhishek Panwar*, Ashok Kumar Thakur

Department of Seed Science and Technology, Dr. Y S Parmar University of Horticulture and Forestry, Nauni. HP-173230, India

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ABSTRACT

The present investigation was carried out to determine the effect of sowing date and seed pelleting and their interaction on plant growth, yield and quality of bulb crop. All the factors in experiment as well as their interactions showed significant influence on plant growth, yield and yield contributing characters in onion. The seeds pelleted with *Azadirechta indica* leaf powder + clay and *Melia azedarach* leaf powder + clay sown directly showed maximum values w.r.t. emergence (91.50 %), plant height at 60 days after sowing (35.35 cm), average leaf length (38.43cm), number of leaves per plant (8.67), number of days to harvesting (233.49). polar diameter (46.72 mm), equatorial diameter (57.77 mm), bulb size index (2699.74), neck thickness (12.12 mm), number of bulb per plot (89.00) average bulb weight (75.24 g), bulb yield (6.67 kg per plot or 400.01 q per ha), plant height before neck fall stage (58.55 cm). From the present studies, it can be concluded that onion seeds pelleted with *Azadirechta indica* leaf powder + clay and *Melia azedarach* leaf powder + clay showed significant effects for enhancing seed quality, growth, quality and yield of bulb crop raised through direct seeding.

Keywords: Pelleting, Onion, Botanicals, Clay, Gum Arabica, Seed quality.

INTRODUCTION

Onion (*Allium cepa* L.), a member of family Alliaceae, is a monophyletic monocot under the clad *Liliales* as classified based on cladistic methodology, genomics and molecular polygenetic relationships (Sharma and Sharma, 2006). Seed, being the basic input in crop raising, plays a vital role in crop stand, growth and yield as well as the productivity of the other inputs used in crop production. Seed pelleting in one of seed treatment methods by which the seed is enclosed with the small quantity of filler material just large enough to produce the globular unit of standard size to facilitate precision planting (Vanangamudi *et al*., 2010).

Seed pelleting is a mechanism of applying various materials to the seed that can enhance the seed quality with respect to physiological, physical and health attributes. Seed pelleting also serves as mechanism of applying needed material in such a way that they affect the seed or soil at the seed-soil interface. The main objective of seed pelleting is precision sowing with added advantages of better establishment and increased productivity. Seed pelleting make it easy to handle small and irregular shaped seeds. Seed pelleting with leaf powder not only improves the health and physiological quality of seeds by way of protecting the seeds from fungal and insect attack but also improves seed and soil relationships through enriching the rhizosphere region of seed. The treated seed produce uniform seedling stand as these can be placed precisely in field and helps to attain maximum yield. However, recommendations on sowing time of direct seeded onion are lacking. The direct seeding of pelleted onion need to be precisely studied to avoid production problems like early bolting and delayed harvesting that coincide with monsoon rains resulting in loss of yield and quality. The objective of this study was to determine the effect of sowing date and seed pelleting and their interaction on plant growth, yield and quality of bulb crop.

MATERIALS AND METHODS

The experimental material used for the present investigation was Palam Lohit variety of onion. Palam Lohit is a high yielding variety with an average bulb yield of 450 quintal per hectare. The experiment was laid out during two years (2016-17 and 2017-18) in split plot design with 14 treatment combinations replicated three times. This experiment comprised of pelleted seeds with *Acorus calamus* leaf powder + clay, *Vitex negendu* leaf powder + clay, *Melia azedarach* leaf powder + clay, *Albezia chinensis* leaf powder + clay, *Adhatoda vasica* leaf powder + clay, *Tegetus* species leaf powder + clay, *Artemesia roxburghiana* leaf powder + clay, *Lantana camara* leaf powder + clay, *Eucalyptus* species leaf powder + clay, *Azadirechta indica* leaf powder + clay, *Cinnamomum camphora* leaf powder + clay, *Cymbopogan flexuosus* leaf powder + clay, clay, unpelleted seed (control) and different sowing dates with Last week of October (31st) (D1), 10 days after first sowing Nov (11th) (D2), 10 days after first sowing Nov (11th) (D3) and 30 days after first sowing Dec (2nd) (D4). Observations were recorded for bulb crop characters i.e.

*Author for Correspondence: jackpanwar@gmail.com

Table 1: Effect of seed pelleting and sowing dates on emergence (%) in onion cv. Palam lohit

Sowing dates / Pelleting	Year 2016-17					Year 2017-18					Pooled				
	D1	D2	D3	D4	Mean	D1	D2	D3	D4	Mean	D1	D2	D3	D4	Mean
P1	88.00 (64.54)	87.00 (68.48)	86.00 (65.14)	82.00 (63.74)	85.75 (65.48)	90.00 (65.99)	88.00 (60.31)	86.00 (66.19)	80.00 (59.50)	86.00 (63.00)	89.00 (65.27)	87.50 (64.40)	86.00 (65.67)	81.00 (61.62)	85.88 (64.24)
P2	87.00 (59.82)	88.00 (59.45)	85.00 (57.40)	80.00 (62.95)	85.00 (59.91)	86.00 (68.19)	89.00 (63.55)	84.00 (56.61)	82.00 (63.78)	85.25 (63.03)	86.50 (64.01)	88.50 (61.50)	84.50 (57.01)	81.00 (63.37)	85.13 (61.47)
P3	89.67 (65.11)	89.33 (62.78)	89.33 (59.62)	86.00 (56.31)	88.67 (60.95)	91.33 (58.53)	89.00 (63.75)	88.33 (56.93)	85.33 (66.03)	88.50 (61.31)	90.50 (61.82)	89.17 (63.26)	88.30 (58.28)	85.83 (61.17)	88.58 (61.13)
P4	84.00 (56.93)	85.00 (52.66)	84.00 (59.40)	80.00 (62.55)	83.25 (57.89)	86.00 (62.29)	86.00 (52.12)	85.00 (61.10)	79.00 (55.74)	84.00 (57.81)	85.00 (59.61)	85.50 (52.39)	84.50 (60.25)	79.50 (59.15)	83.63 (57.85)
P5	86.00 (61.03)	85.00 (57.68)	86.00 (55.08)	83.00 (55.80)	85.00 (57.40)	87.00 (61.20)	84.00 (56.70)	87.00 (63.12)	85.00 (56.94)	85.75 (59.49)	86.50 (61.11)	84.50 (57.19)	86.50 (59.10)	84.00 (56.37)	85.38 (58.44)
P6	88.00 (51.91)	86.00 (57.69)	84.00 (60.89)	84.00 (58.18)	85.50 (57.17)	88.00 (49.51)	88.00 (59.57)	85.00 (55.11)	83.00 (58.75)	86.00 (55.74)	88.00 (50.71)	87.00 (58.63)	84.50 (58.00)	83.50 (58.47)	85.75 (56.45)
P7	85.00 (57.12)	84.00 (53.85)	83.00 (54.52)	81.00 (49.66)	83.25 (53.79)	86.00 (55.00)	85.00 (61.71)	85.00 (56.29)	84.00 (47.48)	85.00 (55.12)	85.50 (56.06)	84.50 (57.78)	84.00 (55.40)	82.50 (48.57)	84.13 (54.45)
P8	86.00 (65.64)	83.00 (68.36)	85.00 (65.91)	82.00 (63.42)	84.00 (65.83)	88.00 (66.41)	82.00 (61.52)	86.00 (66.87)	85.00 (60.03)	85.25 (63.71)	87.00 (66.03)	82.50 (64.94)	85.50 (66.39)	83.50 (61.73)	84.63 (64.77)
P9	85.00 (59.96)	84.00 (59.54)	84.00 (57.66)	83.00 (63.75)	84.00 (60.23)	89.00 (68.52)	85.00 (63.71)	85.00 (57.46)	85.00 (64.56)	86.00 (63.56)	87.00 (64.24)	84.50 (61.63)	84.50 (57.56)	84.00 (64.16)	85.00 (61.90)
P10	91.00 (65.97)	90.00 (63.90)	90.00 (60.83)	86.00 (57.68)	89.25 (62.10)	92.00 (59.62)	90.00 (64.55)	88.00 (58.45)	85.00 (65.28)	88.75 (61.97)	91.50 (62.80)	90.00 (64.22)	89.00 (59.64)	85.50 (61.48)	89.00 (62.03)
P11	87.00 (57.81)	86.00 (53.31)	85.00 (61.15)	80.00 (63.76)	84.50 (59.01)	88.00 (60.88)	88.00 (52.98)	87.00 (62.22)	82.00 (57.12)	86.25 (58.30)	87.50 (59.34)	87.00 (53.15)	86.00 (61.68)	81.00 (60.44)	85.38 (58.65)
P12	86.00 (63.13)	85.00 (58.26)	86.00 (55.68)	82.00 (56.58)	84.75 (58.41)	85.00 (63.22)	84.33 (57.07)	85.00 (63.03)	82.67 (58.40)	84.25 (60.43)	85.50 (63.17)	84.67 (57.67)	85.50 (59.36)	82.33 (57.49)	84.50 (59.42)
P13	83.00 (52.50)	82.00 (58.53)	82.00 (61.78)	79.00 (58.25)	81.50 (57.77)	85.00 (49.98)	84.00 (60.20)	83.00 (55.71)	79.00 (58.95)	82.75 (56.21)	84.00 (51.24)	83.00 (59.37)	82.50 (58.75)	79.00 (58.60)	82.13 (56.99)
P14	82.00 (56.95)	80.00 (54.58)	79.00 (55.20)	76.00 (49.77)	79.25 (54.13)	84.00 (55.88)	82.00 (62.49)	80.00 (57.05)	76.00 (47.74)	80.50 (55.79)	83.00 (56.42)	81.00 (58.53)	79.50 (56.12)	76.00 (48.76)	79.88 (54.96)
Mean	86.21 (59.88)	85.29 (59.22)	84.86 (59.30)	81.71 (58.74)	84.52 (59.29)	87.52 (60.37)	86.02 (60.01)	85.31 (59.72)	82.36 (58.59)	85.30 (59.68)	85.67 (60.13)	85.10 (59.62)	85.07 (59.51)	82.05 (58.67)	84.93 (59.48)

Figures in the parenthesis are arc sine transformed

$CD_{0.05}$

	2016-17	2017-18		POOLED
P	1.575	1.36	P	0.945
D	0.687	0.761	D	0.554
Factor (D) at the same level of P	2.904	2.87	P X D	2.074
Factor (P) at the same level of D	2.946	2.815	Y	0.376
			Y X P	1.406
			Y X D	NS
			Y X D X P	2.811

plant height 60 DAS (cm), average leaf length (cm), number of leaves per plant, days to harvesting (DAS), polar diameter (mm), equatorial diameter (mm), bulb size index, neck thickness (mm), number of bulbs per plot, average bulb weight (g), bulb yield (kg per plot and q per ha), plant height before neck fall stage (cm), early bolters, splitting and disease incidence. The analysis of variance depicted that there were significant differences among various treatments at 5% level of significance for all traits except number of bulbs per plot, early bolters, splitting.

RESULT AND DISCUSSION

Emergence (%)

Seedling emergence is the foremost component of crop success. The number of seeds that germinate and grow into healthy plant has a direct correlation to the yield and quality of crop. Therefore, it is important to take steps not only during the pre- emergence, but also in the previous growing and harvest periods, that will benefit the plants throughout the growing season. A perusal of data presented in Table 1 indicated that different pelleting materials and different sowing dates and their interactions showed a significant effect on emergence. Highest emergence (89.00 %) was recorded in seeds pelleted with *Azadirechta indica* leaf powder (P_{10}) which was at par with *Melia azedarach* leaf powder (P_3) pelleted seed (88.58%), while the lowest germination (79.88%) was recorded in unpelleted seed (P_{14}). Among the years, maximum

Table 2 Effect of seed pelleting and sowing dates on plant height (cm) 60 DAS in onion cv Palam Lohit

Sowing dates Pelleting	Year 2016-17					Year 2017-18					Pooled				
	D1	D2	D3	D4	Mean	D1	D2	D3	D4	Mean	D1	D2	D3	D4	Mean
P1	30.15	30.16	30.37	28.43	29.78	31.28	30.56	30.42	28.64	30.23	30.72	30.36	30.40	28.54	30.00
P2	31.45	31.85	30.28	29.24	30.71	33.42	31.29	30.83	29.79	31.33	32.44	31.57	30.56	29.52	31.02
P3	34.43	33.89	32.37	30.67	32.84	36.27	35.43	33.28	30.36	33.84	35.35	34.66	32.83	30.52	33.34
P4	30.28	29.85	28.16	26.68	28.74	30.64	29.37	27.48	26.24	28.43	30.46	29.61	27.82	26.46	28.59
P5	32.17	31.46	30.46	27.92	30.50	33.15	32.67	31.57	27.67	31.27	32.66	32.07	31.02	27.80	30.88
P6	33.23	32.83	30.29	27.37	30.93	34.79	33.23	31.46	28.11	31.90	34.01	33.03	30.88	27.74	31.41
P7	30.46	30.27	30.37	28.81	29.98	31.26	30.65	31.44	27.48	30.21	30.86	30.46	30.91	28.15	30.09
P8	30.89	30.38	30.31	27.42	29.75	31.37	30.45	29.27	27.23	29.58	31.13	30.42	29.79	27.33	29.67
P9	31.25	30.52	31.12	28.48	30.34	32.33	31.69	30.28	27.64	30.49	31.79	31.11	30.70	28.06	30.41
P10	34.26	34.10	32.75	30.94	33.01	36.14	35.34	33.64	30.75	33.97	35.20	34.72	33.20	30.85	33.49
P11	31.22	29.64	30.37	29.35	30.15	31.36	29.23	30.11	28.27	29.74	31.29	29.44	30.24	28.81	29.94
P12	32.59	30.49	31.41	29.28	30.94	33.56	31.53	31.37	28.64	31.28	33.08	31.01	31.39	28.96	31.11
P13	29.68	28.39	27.64	26.17	27.97	29.16	28.74	28.45	26.10	28.11	29.42	28.57	28.05	26.14	28.04
P14	27.74	26.69	26.53	25.78	26.69	27.36	26.86	26.64	24.34	26.30	27.55	26.78	26.59	25.06	26.49
Mean	31.41	30.75	30.17	28.32	30.17	32.29	31.22	30.45	27.95	30.48	31.85	30.98	30.31	28.14	30.32

$CD_{0.05}$

	2016-17	2017-18		POOLED
P	0.63	0.64	P	0.45
D	0.62	0.42	D	0.31
Factor (D) at the same level of P	1.31	1.30	P X D	0.90
Factor (P) at the same level of D	1.36	1.30	Y	0.22
			Y X P	0.63
			Y X D	0.43
			Y X D X P	NS

emergence (85.30%) was recorded in the year 2017-18 (Y_2) as compared to the year 2016-17(Y_1). Interaction between years and pelleted seeds (Y x P) showed that the maximum emergence (89.25%) was recorded in Y_1 X P_{10} i.e. *Azadirechta indica* leaf powder pelleted seed during 2016-17. The results are in line with Kumar *et al.* (2015) who reported enhanced emergence in early dates (15th October). Whereas, Mollah *et al.* (2015) with15th November and Khan (2011) with 10th November planting date obtained the increased emergence.

Plant height at 60 days after sowing

Results indicated that different pelleting materials and different sowing dates and their interactions showed a significant effect on plant height in direct sown onion (Table 2). Among seed pelleting, maximum plant height (33.49cm) was recorded with *Azadirachta indica* leaf powder (P_{10}) which was at par with *Melia azedarach* leaf powder (P_3) pelleted seed (33.34 cm), while minimum plant height (26.49cm) was recorded in unpelleted seed (P_{14}). The comparison of years revealed that maximum plant height (30.48cm) was recorded in the year 2017-18 (Y_2) as compared to the year 2016-17 (Y_1). Interaction between years and pelleting (Y x P) showed that the maximum plant height (33.97cm) was recorded in Y_2 X P_{10} i.e. *Azadirachta indica* leaf powder pelleted seed during 2017-18 whereas, minimum plant height (26.30cm) was recorded in Y_2 x P_{14} i.e. unpelleted seed during 2017-18. Interaction between years and date of sowing (Y x D) was also found to be significant. Maximum plant height (32.29cm) was recorded Y_2 x D_1 i.elast week of October during 2017-18 whereas, minimum plant height (27.95cm) was recorded with Y_2 x D_4 i.e. first week of December during 2017-18. Sowing time plays an important role in providing congenial conditions for vegetative growth, flowering and yield (Verma *et al.*, 2011). Onions can be grown under varied type of climatic conditions but mild climate without extremes of temperatures are most suitable. The climatic conditions in November mostly remained mild which are good for its growth and development. On the other hand, Anisuzzaman *et al.* (2009) reported that 21st November sown onion produced tallest plants. Another researcher, Ud-deen (2008) reported that tallest plants of onion were observed when onion is planted on 30th October. The planting dates as reported by various researchers differed with the local microclimate of the regions

Number of leaves per plant

A perusal of data presented in Table 4 indicated that different pelleting materials and different sowing dates and

their interactions showed a significant effect on number of leaves in onion. Maximum number of leaves per plant (8.17) was recorded in plants raised through seeds pelleted with *Azadirachta indica* leaf powder (P_{10}) which was at par with (P_3) *Melia azedarach* leaf powder pelleted seed (8.08). Similar findings of were also observed in cowpea seed pelleted with arrapu leaf powder that showed maximum number of leaves among all the treatments (Dileepkumar *et al*., 2009). Increased number of leaves have also been found in soybean (Supereetgadi, 2004) and cowpea (Masuthi, 2005). Onion can be grown under varied type of climatic conditions but mild climate without extremes of high or low temperatures are most suitable.

Table 3 Effect of seed pelleting and sowing dates on number of leaves per plant in onion cv. Palam Lohit

Sowing dates Pelleting	Year 2016-17					Year 2017-18					Pooled				
	D1	D2	D3	D4	Mean	D1	D2	D3	D4	Mean	D1	D2	D3	D4	Mean
P1	7.33	7.06	6.33	6.33	6.76	7.33	7.06	6.33	6.33	6.76	7.33	7.06	6.33	6.33	6.76
P2	7.33	7.09	6.33	5.67	6.61	7.00	7.09	6.33	6.00	6.61	7.17	7.09	6.33	5.83	6.61
P3	8.59	8.59	7.67	7.33	8.04	8.59	8.25	8.33	7.33	8.13	8.59	8.42	8.00	7.33	8.08
P4	5.99	6.33	6.33	6.00	6.16	5.99	6.33	6.33	6.00	6.16	5.99	6.33	6.33	6.00	6.16
P5	7.00	7.64	7.33	6.33	7.08	6.67	7.64	7.33	6.33	6.99	6.83	7.64	7.33	6.33	7.03
P6	8.35	7.33	6.67	6.33	7.17	8.33	8.33	7.67	7.00	7.83	8.34	7.83	7.17	6.67	7.50
P7	6.31	6.31	6.67	6.33	6.41	6.31	6.31	6.67	6.33	6.41	6.31	6.31	6.67	6.33	6.41
P8	7.63	7.02	6.67	6.67	7.00	7.97	7.02	6.67	6.67	7.08	7.80	7.02	6.67	6.67	7.04
P9	7.56	7.31	6.33	6.67	6.97	7.56	7.31	6.33	6.67	6.97	7.56	7.31	6.33	6.67	6.97
P10	8.67	8.67	7.33	7.67	8.08	8.67	8.67	8.00	7.67	8.25	8.67	8.67	7.67	7.67	8.17
P11	7.34	6.67	6.67	6.33	6.75	7.34	6.67	6.67	6.33	6.75	7.34	6.67	6.67	6.33	6.75
P12	8.59	8.00	7.33	7.33	7.81	8.36	8.33	7.67	7.33	7.92	8.47	8.17	7.50	7.33	7.87
P13	7.24	6.33	6.00	6.00	6.39	7.24	6.33	6.00	6.00	6.39	7.24	6.33	6.00	6.00	6.39
P14	6.33	6.00	5.67	5.67	5.92	6.00	6.00	5.67	5.67	5.83	6.17	6.00	5.67	5.67	5.88
Mean	7.45	7.17	6.67	6.48	6.94	7.38	7.24	6.86	6.55	7.01	7.42	7.20	6.76	6.51	6.97

$CD_{0.05}$

	2016-17	**2017-18**		**POOLED**
P	0.51	0.48	P	0.35
D	0.41	0.39	D	0.24
Factor (D) at the same level of P	1.05	0.98	PX D	0.69
Factor (P) at the same level of D	1.06	1.00	Y	NS
			Y X P	NS
			Y X D	NS
			Y X D X P	NS

Table 4 Effect of seed pelleting and sowing dates on polar bulb diameter (mm) in onion cv. Palam Lohit

Sowing dates Pelleting	Year 2016-17					Year 2017-18					Pooled				
	D1	D2	D3	D4	Mean	D1	D2	D3	D4	Mean	D1	D2	D3	D4	Mean
P1	43.67	42.28	42.12	40.25	42.08	44.46	43.41	42.41	40.41	42.67	44.07	42.85	42.27	40.33	42.38
P2	43.12	41.96	41.30	40.12	41.63	43.11	42.29	40.69	39.29	41.35	43.12	42.13	41.00	39.71	41.49
P3	46.34	45.63	44.52	41.86	44.59	47.10	46.47	45.47	43.47	45.63	46.72	46.05	45.00	42.67	45.11
P4	40.23	39.67	38.43	36.74	38.77	38.46	37.10	36.45	35.14	36.79	39.35	38.39	37.44	35.94	37.78
P5	41.89	40.29	39.26	38.57	40.00	41.96	40.24	39.78	37.24	39.81	41.93	40.27	39.52	37.91	39.90
P6	46.56	45.02	43.34	40.81	43.93	46.43	45.78	43.67	40.72	44.15	46.50	45.40	43.51	40.77	44.04
P7	40.23	40.18	39.69	36.79	39.22	39.33	37.36	38.46	35.26	37.60	39.78	38.77	39.08	36.03	38.41
P8	45.26	43.14	41.35	40.25	42.50	45.99	43.23	41.33	40.32	42.72	45.63	43.19	41.34	40.29	42.61
P9	46.09	44.67	44.13	40.81	43.93	46.17	45.63	43.53	40.46	43.95	46.13	45.15	43.83	40.64	43.94
P10	45.86	45.52	44.65	41.83	44.47	47.19	46.54	45.54	42.36	45.41	46.53	46.03	45.10	42.09	44.94
P11	40.32	40.12	38.68	35.48	38.65	38.46	37.56	36.56	33.34	36.48	39.39	38.84	37.62	34.41	37.57
P12	42.87	41.82	42.83	39.67	41.80	43.11	42.68	42.78	39.63	42.05	42.99	42.25	42.81	39.65	41.92

P13	38.25	38.11	34.88	33.27	36.13	36.78	35.63	33.63	32.45	34.62	37.52	36.87	34.26	32.86	35.38
P14	35.59	34.68	32.32	30.32	33.23	34.14	33.97	31.87	30.87	32.71	34.87	34.33	32.10	30.60	32.97
Mean	42.59	41.65	40.54	38.34	40.78	42.34	41.28	40.16	37.93	40.42	42.46	41.46	40.35	38.13	40.60

$CD_{0.05}$

	2016-17	**2017-18**		**POOLED**
P	0.73	0.71	P	0.50
D	0.65	0.78	D	0.43
Factor (D) at the same level of P	1.49	1.48	P X D	1.01
Factor (P) at the same level of D	1.54	1.57	Y	0.31
			Y X P	0.71
			Y X D	NS
			Y X D X P	NS

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Table 5 Effect of seed pelleting and sowing dates on number of bulbs per plot in onion cv. Palam Lohit

Sowing dates Pelleting	Year 2016-17					Year 2017-18					Pooled				
	D1	D2	D3	D4	Mean	D1	D2	D3	D4	Mean	D1	D2	D3	D4	Mean
P1	86.00	85.00	84.00	80.00	83.75	86.00	85.00	84.00	78.00	83.25	86.00	85.00	84.00	79.00	83.50
P2	85.00	86.00	83.00	79.00	83.25	84.00	86.00	82.00	79.00	82.75	84.50	86.00	82.50	79.00	83.00
P3	89.00	87.00	87.00	84.00	86.75	88.00	87.00	85.00	83.00	85.75	88.50	87.00	86.00	83.50	86.25
P4	83.00	84.00	83.00	78.00	82.00	84.00	84.00	82.00	76.00	81.50	83.50	84.00	82.50	77.00	81.75
P5	84.00	83.00	84.00	80.00	82.75	84.00	81.00	84.00	81.00	82.50	84.00	82.00	84.00	80.50	82.63
P6	86.00	86.00	85.00	80.00	84.25	87.00	86.00	82.00	80.00	83.75	86.50	86.00	83.50	80.00	84.00
P7	83.00	83.00	84.00	79.00	82.25	84.00	82.00	83.00	80.00	82.25	83.50	82.50	83.50	79.50	82.25
P8	84.00	81.00	82.00	77.00	81.00	85.00	80.00	82.00	82.00	82.25	84.50	80.50	82.00	79.50	81.63
P9	84.00	82.00	82.00	78.00	81.50	85.00	83.00	82.00	82.00	83.00	84.50	82.50	82.00	80.00	82.25
P10	89.00	89.00	88.00	84.00	87.50	89.00	88.00	85.00	83.00	86.25	89.00	88.50	86.50	83.50	86.88
P11	86.00	82.00	83.00	78.00	82.25	85.00	85.00	84.00	80.00	83.50	85.50	83.50	83.50	79.00	82.88
P12	84.00	83.00	84.00	80.00	82.75	84.00	83.00	83.00	82.00	83.00	84.00	83.00	83.50	81.00	82.88
P13	82.00	80.00	80.00	76.00	79.50	83.00	81.00	81.00	74.00	79.75	82.50	80.50	80.50	75.00	79.63
P14	80.00	78.00	77.00	73.00	77.00	83.00	80.00	78.00	70.00	77.75	81.50	79.00	77.50	71.50	77.38
Mean	84.64	83.50	83.29	79.00	82.61	85.07	83.64	82.64	79.29	82.66	84.86	83.57	82.96	79.14	82.63

$CD_{0.05}$

	2016-17	2017-18		POOLED
P	1.64	1.62	P	1.14
D	0,82	1.23	D	0.73
Factor (D) at the same level of P	3.32	3.30	P X D	2.29
Factor (P) at the same level of D	3.27	3.33	Y	NS
			Y X P	NS
			Y X D	NS
			Y X D X P	NS

Table 6 Effect of seed pelleting and sowing dates on bulb yield (kg / plot) in onion cv. Palam Lohit

Sowing dates Pelleting	Year 2016-17					Year 2017-18					Pooled				
	D1	D2	D3	D4	Mean	D1	D2	D3	D4	Mean	D1	D2	D3	D4	Mean
P1	6.35	6.28	6.02	5.27	5.98	6.32	6.16	6.06	5.05	5.90	6.34	6.22	6.04	5.16	5.94
P2	5.91	6.09	5.82	5.11	5.73	5.92	6.04	5.74	4.92	5.66	5.92	6.07	5.78	5.01	5.69
P3	6.40	6.41	6.37	5.50	6.17	6.44	6.33	6.19	5.45	6.10	6.42	6.37	6.27	5.47	6.13
P4	5.48	5.61	5.61	4.89	5.40	5.60	5.64	5.58	4.66	5.37	5.54	5.62	5.59	4.78	5.38
P5	5.77	5.93	5.89	5.05	5.66	6.06	5.87	6.03	5.13	5.77	5.91	5.90	5.96	5.09	5.72

P6	6.30	6.21	6.10	5.00	5.90	6.13	6.16	5.91	5.04	5.81	6.22	6.19	6.00	5.02	5.86
P7	5.91	5.50	5.68	4.85	5.48	5.69	5.44	5.66	4.90	5.42	5.80	5.47	5.67	4.87	5.45
P8	6.46	5.81	5.75	4.82	5.71	6.17	5.70	5.79	5.12	5.70	6.31	5.76	5.77	4.97	5.70
P9	5.81	5.75	5.78	4.79	5.53	6.04	5.84	5.76	5.09	5.68	5.92	5.80	5.77	4.94	5.61
P10	6.53	6.56	6.45	5.55	6.27	6.82	6.63	6.34	5.54	6.33	6.67	6.59	6.39	5.54	6.30
P11	5.98	5.54	5.52	4.80	5.46	5.72	5.64	5.55	4.90	5.45	5.85	5.59	5.54	4.85	5.46
P12	5.92	5.69	5.78	4.98	5.59	5.95	5.76	5.84	5.11	5.67	5.94	5.72	5.81	5.05	5.63
P13	5.43	5.16	5.14	4.65	5.10	5.43	5.24	5.19	4.44	5.08	5.43	5.20	5.17	4.54	5.09
P14	5.18	4.86	4.71	4.34	4.77	5.16	4.87	4.78	4.05	4.72	5.17	4.87	4.75	4.19	4.74
Mean	5.96	5.81	5.76	4.96	5.63	5.96	5.81	5.74	4.96	5.62	5.96	5.81	5.75	4.96	5.62

$CD_{0.05}$

	2016-17	2017-18		POOLED
P	0.134	0.158	P	0.103
D	0.096	0.127	D	0.066
Factor (D) at the same level of P	0.274	0.323	P X D	0.206
Factor (P) at the same level of D	0.275	0.329	Y	NS
			Y X P	NS
			Y X D	NS
			Y X D X P	NS

Polar bulb diameter

Data pertaining to the effect of different pelleting material and different sowing dates and their interactions showed a significant effect on polar bulb diameter has been presented in Table 6 . Maximum polar bulb diameter (45.11mm) was recorded with *Melia azedarach* leaf powder (P_3) which was at par with *Azadirachta indica* leaf powder (P_{10}) pelleted seed (44.94 mm) and minimum polar bulb diameter (32.97 mm) was recorded in unpelleted seed (P_{14}). Effect of years revealed that maximum polar bulb diameter (40.78mm) was resulted in the year 2016-17 (Y_1) as compared to the year 2017-18(Y_2). Interaction between years and pelleted seeds (Y x P) showed that the maximum polar bulb diameter (45.63mm) was recorded in Y_2 x P_3 i.e. *Melia azedarach* during 2017-18.whereas, minimum polar bulb diameter (32.71mm) was recorded in Y_2 x P_{14} i.e. unpelleted seed during 2017-18. The enhanced girth due to pelleting with *Azadirachta indica* leaf powder was recorded by Shashibhaskar *et al*. (2011) in tomato. Similar finding has been reported by Anbarsan *et al.* (2016) in red gram pelleted with *tulsi* leaf powder, Prakash *et al*. (2014) in okra seed pelleted with pungum leaf powder. The increase in physiological process through micronutrients present in different botanicals role in development of cell wall, cell differentiation, root elongation and shoot growth, through active photosynthesis, which ultimately helped towards increase in growth of crop as reported by Singh and Verma (1991).

Number of bulb per plot

A perusal of data presented in Table 10 indicated that different pelleting materials and different sowing dates and their interactions showed a significant effect on number of bulb per plot. Maximum number of bulb per plot (86.88) was recorded with *Azadirachta indica* leaf powder (P_{10}) which was at par with *Melia azedarach* leaf powder (P_3) pelleted seed (86.25) and minimum number of bulb per plot (77.38) was recorded in unpelleted seed (P_{14}). Among the sowing dates, D_1 (last week of October) sowing dates resulted into maximum number of bulb per plot (84.86) and minimum number of bulb per plot (79.14) was recorded with (first week of December) sowing date. Interaction effect revealed that treatment combination P_{10} x D_1 i.e. *Azadirachta indica* leaf powder pelleted seed during last week of October resulted maximum number of bulb per plot (89.00). However, minimum number of bulb per plot (71.50) was recorded in treatment combination P_{14} x D_4 i.e. unpelleted seed during first week of December.

Bulb yield (kg/plot)

A perusal of data presented in Table 12 indicated that different pelleting materials and different sowing dates and their interactions showed a significant effect on bulb yield. Maximum bulb yield (6.30 kg) was recorded with *Azadirachta indica* leaf powder (P_{10}) followed by *Melia azedarach* leaf powder (P_3) pelleted seed (6.13 kg) and minimum bulb yield (4.74 kg) was recorded in unpelleted seed (P_{14}). Among the sowing dates, (last week of October) sowing dates resulted into maximum bulb yield (5.96 kg) and minimum bulb yield (4.96 kg) was recorded with (first week of December) sowing date. Interaction effect revealed that treatment combination P_{10} x D_1 i.e. *Azadirachta indica* leaf powder pelleted seed during last week of October resulted maximum bulb yield (6.67 kg). However, minimum bulb yield (4.19 kg) was recorded in treatment combination P_{14} x D_4 i.e.unpelleted seed during first week of December.

CONCLUSION

From the present studies, it can be concluded that onion seeds pelleted with *Azadirechta indica* leaf powder + clay and *Melia azedarach* leaf powder + clay resulted in higher average leaf length, number of leaves per plant, plant height before neck fall stage, polar diameter, equatorial

diameter, bulb size index, bulb yield. So with the help of seed pelleting with different botanicals the plant growth, seed yield and quality of onion can be improved.

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