RESEARCH ARTICLE Agricultural Science Digest, Volume 41 Special Issue: 169-174 (April 2021)

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

Abhishek Panwar, Ashok K Thakur, Pramod Sharma,
Shivangi Negi, Cherry Nalwa, Anjay Bisht

10.18805/ag.D-5183

ABSTRACT

Background: Onion (*Allium cepa* L.) is a major bulbous vegetable as well as condiment of family Alliaceae grown in India, originated in Iran and Pakistan. 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 make it easy to handle small and irregular shaped seeds.

Methods: The present investigation was conducted in the field of Department of Seed Science and Technology, Dr. Y. S. Parmar University of Horticulture and Forestry, Nauni, Solan during seasons of 2016-17 and 2017-18.

Result: This experiment comprised of pelleted seeds with different botanicals carried out to determine the effect of sowing dates and seed pelleting and their interactions on plant growth, yield and quality of bulb crop. All the factors in the 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 bulb quality, growth, quality and yield of bulb crop raised through direct seeding.

Key words: Arabica, Botanicals, Clay, Gum, Onion, Pelleting, 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). Originated in Central Asia, onion is now grown and consumed almost in all parts of the world. Globally, onion production is to the tune of 88.48 and 4.17 million tonnes in respect of fresh and dry onion, respectively from an area of 5.5 million hectares during 2014-15 (Anonymous, 2016). In India, onion is grown in an area of 1.27 million hectares with a production of 21.56 million metric tonnes having a productivity of 16.98 tonnes per hectare during 2016-2017 (Anonymous, 2017). Onion occupies a remarkable place in Indian economy as it occupies 7.4 per cent of total area under vegetables and 5.7 per cent of the total vegetable output in the country. Seed pelleting is a method 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 method of applying needed various 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. 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.

Department of Seed Science and Technology, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni-173 230, Himachal Pardesh, India.

Corresponding Author: Abhishek Panwar, Department of Seed Science and Technology, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni-173 230, Himachal Pardesh, India.
Email: drabhishekpanwar@gmail.com

How to cite this article: Panwar, A., Thakur, A.K., Sharma, P., Negi, S., Nalwa, C. and Bisht, A. (2021). Effect of Sowing Dates and Botanical Seed Pelleting on Plant Growth, Bulb Yield and Quality of Onion (*Allium cepa* L.). Agricultural Science Digest. 41 (Special Issue): 169-174. DOI: 10.18805/ag.D-5183.

Submitted: 02-04-2020 **Accepted:** 04-09-2020 **Online:** 17-12-2020

MATERIALS AND METHODS

The experiment was laid out during years (2016-17) and (2017-18) in a split plot design with three replications. 56 treatment combinations with two factors four sowing dates

and 14 seed pelleting treatments .The seeds of onion cultivar Palam Lohit were sown as per the treatments in a plot having size of 1.5 m × 1.0 m *i.e*. 1.5 m^2. Row to row and plant to plant spacing of 15 cm × 10 cm was maintained in a plot which accommodated 100 plants per plot. All the standard cultural practices (other than the treatments under studies) for raising a healthy crop of onion recommended in the package of practices for vegetable crops of Dr. Y. S. Parmar University of Horticulture and Forestry, Nauni, Solan, was followed (Anonymous, 2010).

Treatments details

Dr. Y S Parmar University of Horticulture and Forestry, Nauni, Solan (HP) is located at an altitude of 1025 meters above mean sea level with latitude of 30°51′06″ N and longitude of 77°10′56″ E in the mid-hill zone of Himachal Pradesh. 1183 meters above mean sea level with latitude of 30.5°N and longitude of 77.09° E in the mid hill zone of Himachal Pradesh, India. Climate of the area is generally sub-temperate and semi-humid characterized by cold winters. Generally, December and January months are the coldest while, May and June are the hottest months.

During the course of investigations (May), the maximum average temperature of 30.5°C and 30.7°C during 2016-17 and 2017-18, respectively, it was minimum were recorded in the month of January (16.9°C and 19.1°C during 2016-17 and 2017-18, respectively). The average rainfall during 2016-17 was maximum (122.20 mm) in January month and during 2017-18 was maximum (115.00 mm) during May. On the other hand minimum rainfall (Nil) during 2016-17 was recorded in the month of October, November and during 2017-18 it was minimum (nil) in the month of October. The average relative humidity was maximum 60.00% in December 2016-17 and 69.00 % during November 2017-18 and the lowest in May (41.00 %) during 2016-17 and in April (44.00%) during 2017 -18.

Factor 1: Sowing dates.

Sowing dates	Symbol used
Last week of October (31st)	D1
10 days after first sowing Nov (11th)	D2
20 days after first sowing Nov (22nd)	D3
30 days after first sowing Dec (2nd)	D4

Factor 2: Seed pelleting.

Pelleting	Symbol used	Common name
Acorus calamus + clay	P1	Bach
Vitex negendu + clay	P2	Bana
Melia azedarachta + clay	P3	Darek
Albezia chinensis +clay	P4	Chugi
Adhatoda vasica + clay	P5	Basuti
Tegetus species +clay	P6	Wild Genda
Artemesia roxburghiana + clay	P7	Chamber
Lantana camara + clay	P8	Phool Lakdi
Eucalyptus species + clay	P9	Eucalyptus
Azadirechta indica + clay	P10	Neem
Cinnamomum camphora + clay	P11	Camphor
Cymbopogan flexuosus + clay	P12	Lemon Grass
Clay	P13	
Control (unpelleted)	P14	

*Gum Arabica is used as adhesive in all treatments except control.

Pellleting procedure and composition of material

The plant leaves of different botanicals were collected from university and nearby area. Sun dried leaves made in to fine powdered form with the help of grinder. After grinding a fine leaf powder was obtained by sieving through 0.10 mm wire mesh. The filler materials clay was mixed with botanicals powder in definite proportion 1:4 by volume and gum arabica (5%) used as adhesive. using SATEC EQUIPMENT for seed pelleting. 50 g seeds were put in the rotating drum and the combination of filler materials and botanical powders as an inert matter are sprinkled on the seeds and are rolled for effective and uniform coating. The thickness of the pelleted seed was depending on the amount of adhesive in relation to the amount of seed. So that pelleting mixture was coated on to the seed uniformly in required proportion. After pelleting pelleted seeds were air dried under the shade for two days.

RESULTS 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 percentage. The highest emergence (89.00%) was recorded in the seeds pelleted with *Azadirechta indica* leaf powder (P_{10}) which was at par with *Melia azedarachta* leaf powder (P_3) pelleted seed (88.58%), while the lowest germination (79.88%) was recorded in unpelleted seed (P_{14}). Among the date of direct sowing, sowing during last week of October (D_1) resulted into the highest germination (85.67%), while the lowest germination (82.05%) was recorded in the seed sown during first week of December (D_4). Interaction effects of pelleting and date of direct sowing revealed that seeds pelleted with *Azadirechta indica* leaf powder sown directly during last week of October ($P_{10} \times D_1$) recorded the highest emergence (91.50%). However, the lowest emergence (76.00 %) was recorded in unpelleted seeds sown directly during first week of December ($P_{14} \times D_4$).

The enhanced emergence due to pelleting with *Azadirechta indica* leaf powder was recorded by Shashibhaskar *et al.* (2011) in tomato. They also reported that botanicals contain growth promoting substance and nutrients which helps for better seedling performance. The

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

Sowing dates	Year 2016-17					Year 2017-18					Pooled				
pelleting	D1	D2	D3	D4	Mean	D1	D2	D3	D4	Mean	D1	D2	D3	D4	Mean
P1	88.00	87.00	86.00	82.00	85.75	90.00	88.00	86.00	80.00	89.00	87.50	86.00	86.00	81.00	85.88
	(64.54)	(68.48)	(65.14)	(63.74)	(65.48)	(65.99)	(60.31)	(66.19)	(59.50)	(63.00)	(65.27)	(64.40)	(65.67)	(61.62)	(64.24)
P2	87.00	88.00	85.00	80.00	85.00	86.00	89.00	84.00	82.00	85.25	86.50	88.50	84.50	81.00	85.13
	(59.82)	(59.45)	(57.40)	(62.95)	(59.91)	(68.19)	(63.55)	(56.61)	(63.78)	(63.03)	(64.01)	(61.50)	(57.01)	(63.37)	(61.47)
P3	89.67	89.33	89.33	86.00	88.67	91.33	89.00	88.33	85.33	88.50	90.50	89.17	88.30	85.83	88.58
	(65.11)	(62.78)	(59.62)	(56.31)	(60.95)	(58.53)	(63.75)	(56.93)	(66.03)	(61.31)	(61.82)	(63.26)	(58.28)	(61.17)	(61.13)
P4	84.00	85.00	84.00	80.00	83.25	86.00	86.00	85.00	79.00	84.00	85.00	85.50	84.50	(59.15)	83.63
	(56.93)	(52.66)	(59.40)	(62.55)	(57.89)	(62.29)	(52.12)	(61.10)	(55.74)	(57.81)	(59.61)	(52.39)	(60.25)	79.50	(57.85)
P5	86.00	85.00	86.00	83.00	85.00	87.00	84.00	87.00	85.00	85.75	86.50	84.50	86.50	84.00	85.38
	(61.03)	(57.68)	(55.08)	(55.80)	(57.40)	(61.20)	(56.70)	(63.12)	(56.94)	(59.49)	(61.11)	(57.19)	(59.10)	(56.37)	(58.44)
P6	88.00	86.00	84.00	84.00	85.50	88.00	88.00	85.00	83.00	86.00	88.00	87.00	84.50	83.50	85.75
	(51.91)	(57.69)	(60.89)	(58.18)	(57.17)	(49.51)	(59.57)	(55.11)	(58.75)	(55.74)	(50.71)	(58.63)	(58.00)	(58.47)	(56.45)
P7	85.00	84.00	83.00	81.00	83.25	86.00	85.00	85.00	84.00	85.00	85.50	84.50	84.00	82.50	84.13
	(57.12)	(53.85)	(54.52)	(49.66)	(53.79)	(55.00)	(61.71)	(56.29)	(47.48)	(55.12)	(56.06)	(57.78)	(55.40)	(48.57)	(54.45)
P8	86.00	83.00	85.00	82.00	84.00	88.00	82.00	86.00	85.00	85.25	87.00	82.50	85.50	83.50	84.63
	(65.64)	(68.36)	(65.91)	(63.42)	(65.83)	(66.41)	(61.52)	(66.87)	(60.03)	(63.71)	(66.03)	(64.94)	(66.39)	(61.73)	(64.77)
P9	85.00	84.00	84.00	83.00	84.00	89.00	85.00	85.00	85.00	86.00	87.00	84.50	84.50	84.00	85.00
	(59.96)	(59.54)	(57.66)	(63.75)	(60.23)	(68.52)	(63.71)	(57.46)	(64.56)	(63.56)	(64.24)	(61.63)	(57.56)	(64.16)	(61.90)
P10	91.00	90.00	90.00	86.00	89.25	92.00	90.00	88.00	85.00	88.75	91.50	90.00	89.00	85.50	89.00
	(65.97)	(63.90)	(60.83)	(57.68)	(62.10)	(59.62)	(64.55)	(58.45)	(65.28)	(61.97)	(62.80)	(64.22)	(59.64)	(61.48)	(62.03)
P11	87.00	86.00	85.00	80.00	84.50	88.00	88.00	87.00	82.00	86.25	87.50	87.00	86.00	81.00	85.38
	(57.81)	(53.31)	(61.15)	(63.76)	(59.01)	(60.88)	(52.98)	(62.22)	(57.12)	(58.30)	(59.34)	(53.15)	(61.68)	(60.44)	(58.65)
P12	86.00	85.00	86.00	82.00	84.75	85.00	84.33	85.00	82.67	84.25	85.50	84.67	85.50	82.33	84.50
	(63.13)	(58.26)	(55.68)	(56.58)	(58.41)	(63.22)	(57.07)	(63.03)	(58.40)	(60.43)	(63.17)	(57.67)	(59.36)	(57.49)	(59.42)
P13	83.00	82.00	82.00	79.00	81.50	85.00	84.00	83.00	79.00	82.75	84.00	83.00	82.50	79.00	82.13
	(52.50)	(58.53)	(61.78)	(58.25)	(57.77)	(49.98)	(60.20)	(55.71)	(58.95)	(56.21)	(51.24)	(59.37)	(58.75)	(58.60)	(56.99)
P14	82.00	80.00	79.00	76.00	79.25	84.00	82.00	80.00	76.00	80.50	83.00	81.00	79.50	76.00	79.88
	(56.95)	(54.58)	(55.20)	(49.77)	(54.13)	(55.88)	(62.49)	(57.05)	(47.74)	(55.79)	(56.42)	(58.53)	(56.12)	(48.76)	(54.96)
Mean	86.21	85.29	84.86	81.71	84.52	87.52	86.02	85.31	82.36	85.30	85.67	85.10	85.07	82.05	84.93
	(59.88)	(59.22)	(59.30)	(58.74)	(59.29)	(60.37)	(60.01)	(59.72)	(58.59)	(59.68)	(60.13)	(59.62)	(59.51)	(58.67)	(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 × D	2.074
Factor (P) at the same level of D	2.946	2.815	Y	0.376
			Y × P	1.406
			Y × D	NS
			Y × D × P	2.811

increase in physiological process through micronutrients present in different botanicals play an important 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). The experiment conducted by Prakash *et al.* (2018) revealed that enhanced emergence was observed in black gram seed pelleted with pungum leaf powder. Similar results have been reported due to seed pelleting with various leaf powders in red gram (Anbarsan *et al.,* 2016), okra (Prakash *et al.,* 2014) and chillies (Jerlin *et al.,* 2008).The results are also in line with Kumar *et al.* (2015) who reported enhanced emergence in early dates (15th October). However, Mollah *et al.,* 2015 and Khan (2011) obtained the increased emergence with 15th November and 10th November planting date, respectively.

Polar bulb diameter

The data pertaining to effect of different pelleting material and different sowing dates and their interactions showed significant effect on polar bulb diameter has been presented in (Table 2). 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 (45.63 mm) was recorded in $Y_{2 x}$ P_3 *i.e*. *Melia azedarachta* 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 3) indicated that different pelleting materials and different sowing dates and their interactions showed 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 azedarachta* leaf powder (P_3) pelleted seed (86.25) and minimum number of bulb per plot (77.38)

Table 2: Effect of seed pelleting and sowing dates on polar bulb diameter (mm) in onion cv. Palam Lohit.

Sowing dates	Year 2016-17					Year 2017-18					Pooled				
pelleting	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 × D	1.01
Factor (P) at the same level of D	1.54	1.57	Y	0.31
			Y × P	0.71
			Y × D	NS
			Y × D × P	NS

Table 3: Effect of seed pelleting and sowing dates on number of bulbs per plot in onion cv. Palam Lohit.

Sowing dates	Year 2016-17					Year 2017-18					Pooled				
Pelleting	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 × D	2.29
Factor (P) at the same level of D	3.27	3.33	Y	NS
			Y × P	NS
			Y × D	NS
			Y × D × P	NS

Table 4: Effect of seed pelleting and sowing dates on bulb yield (kg / plot) in onion cv. Palam Lohit.

Sowing dates	Year 2016-17					Year 2017-18					Pooled				
Pelleting	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 × D	0.206
Factor (P) at the same level of D	0.275	0.329	Y	NS
			Y × P	NS
			Y × D	NS
			Y × D × P	NS

was recorded in unpelleted seed (P_{14}). Among the sowing dates, D1 (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 $P_{10} \times D_1$ *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 $P_{14} \times D_4$ *i.e*. unpelleted seed during first week of December.

Bulb yield (kg/plot)

A perusal of data presented in Table 4 indicated that different pelleting materials and different sowing dates and their interactions showed significant effect on bulb yield. Maximum bulb yield (6.30 kg) was recorded with *Azadirachta indica* leaf powder (P_{10}) followed by *Melia azedarachta* 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 $P_{10} \times D_1$ *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 $P_{14} \times D_4$ *i.e*. unpelleted seed during first week of December.

CONCLUSION

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).Observations were recorded for bulb crop characters i.e. 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).

The seeds pelleted with *Azadirechta indica* leaf powder + clay direct shown in last week of October showed maximum values with respect to 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). This treatment was closely followed by *Melia azedarach* leaf powder + clay pelleted seeds directly sown in last week of October.

ACKNOWLEDGEMENT

The authors wish to acknowledge the head of Department of Seed Science and Technology, Dr. Y S Parmar University of Horticulture and Forestry Nauni Solan HP for the facilities given at the time of investigation.

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