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Physiological Parameters Influenced by Dates of Bulb Planting and Application of Foliar Nutrition on Onion cv. Arka Kalyan

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ABSTRACT

Onion demand in domestic and international market is increasing day by day but non-availability of good quality seed is limitation for profitable seed production programme of onion. Hence an experiment was conducted to study the effect of dates of bulb planting and application of foliar nutrition on physiological parameters of onion during the Rabi season 2015-16 and 2016-17. The experiment consisted of five dates of bulb planting with four applications of foliar nutrition and was laid out in Randomized Complete Block Design (RCBD) with two factorial concepts. The experimental results revealed the significant effect of dates of bulb planting and application of foliar nutrition on physiological traits. Significantly less values were recorded in the parameters like chlorophyll content (69.50 and 72.50), dry matter accumulation (5.03 and 8.52 g) 40 and 60 days after planting, days to flower initiation (37.71), days to 50 % flowering (55.77), more values in pollen viability (87.23), pollen germination (70.07) were recorded by planting the bulbs on November-1st coupled with application of multi micronutrient mixture at 0.25 per cent (D_3T_3) and significantly the lowest was recorded by December-1st planting with without spray (D_5T_4).

Key words: *Chlorophyll, Foliar spray, Pollen, Onion*

INTRODUCTION

Onion (*Allium cepa L.*) is one of the major spice bulb crops of the world and India. It has great economic importance due to its medicinal and dietetic values. Onion is a biennial crop. It completes vegetative phase with bulb production in the first year. The bulbs are used as planting material for production of true seed in the second year. The demands of quality true seeds are increasing day by day and the price of quality seeds is also high. Onion is a thermo and photosensitive crop; the seeds are produced during winter period *(Rabi* season). Foggy weather at early stage of crop growth and early rain at the flowering stage adversely affect the seed crop. Thus, the time of planting of bulbs for true seed production in a particular location needs to be determined for quality seed production of onion[2].

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Planting date may vary in different localities as well as agro ecological zones and even from year to year at the same place due to climate change. The environmental conditions greatly.

Influence the growth and development of onion plant. Different growth phases of onion have varied environmental requirements. Besides time of bulb planting, plant nutrition also influences the crop growth, seed yield and quality. The application of foliar nutrition is the quickest way to deliver nutrients to the tissues and organs of the crop, and is proved that application of these micronutrients beneficial to correct the certain nutrient deficiencies. Keeping all these above facts in view, the present investigation "effect of bulb planting dates and foliar application of nutrition on physiological parameters of onion," was undertaken.

MATERIALS AND METHODS

The field experiment was conducted by using foundation seeds Cv. Arka kalyana obtained from Seed unit, UAS, Dharwad at 'H' block, seed unit, University of Agricultural Sciences, Dharwad, during *rabi* -2015-16 and 2016-17 to study the effect of five dates of bulb planting *viz*., **D_1**:October-1st, **D_2**:October-15th, **D_3**:November-1st, **D_4**:November-15th and **D_5**:December-1st and four types of application of foliar nutrition viz., **T_1:**Borax @ 0.25 %, **T_2**:Potassium nitrate @ 0.5 %, **T_3**:Micronutrient mixture @ 0.25 % (Nutrient content on % basis *i.e.* Zinc 3.0 %, Iron 2.0 %, Manganese 1.0 %, Boron 0.50 % and other composition of calcium, sulphur, molybdenum *etc.*) and **T_4**:Control.The experiment was laid out in Randomized Complete Block Design (RCBD) with two factorial concepts.

Pollen fertility percentage

Pollen was collected at 50 % flowering and fertility percentage was observed under microscope using acetocarmine (2 %) stain. Stained pollens were considered as fertile and unstained pollen are sterile was counted and percent fertility was assessed.

$$\text{Pollen fertility (\%)} = \frac{\text{Number of sterile pollen}}{\text{Total Number of pollen}} \text{ X } 100$$

Pollen germination percentage

The collected pollens were incubated for 2-4 hours in a germinating media composed of sucrose. 2 µL droplets were put on the slide and it was observed under compound microscope for the germinated pollens and the percentage was assessed.

$$\text{Pollen germination (\%)} = \frac{\text{Number of germinated pollen}}{\text{Total Number of pollen}} \text{X } 100$$

Chlorophyll content (SPAD value)

SPAD is a plant analysis technique developed by IRRI, Philippines for nitrogen management in rice crop. A SPAD value was recorded on top third leaf. For each leaf, five values recorded and average SPAD value was computed.

RESULTS AND DISCUSSION

The data with respect to days to flower initiation, days to 50 % flowering, days to maturity, pollen viability, pollen germination, chlorophyll content and dry matter accumulation during seed production of onion cv. Arka Kalyan during the year 2015-16, 2016-17 and in pooled over two years due to different dates of bulb planting, foliar application of nutrition and their interaction effects are presented in Table 1 to 5.

Dates of bulb planting (D)

Irrespective of the foliar application of nutrition, the pooled results showed the significant variations for all physiological parameters due to the dates of bulb planting.

Significantly less number of days to flower initiation (41.46), days to 50 % flowering (57.06), more pollen viability (79.18 %), pollen germination (61.26 %), chlorophyll content (63.41 and 66.78) and dry matter accumulation (4.23 and 7.66 g) @ 40 and 60 days after planting was recorded in November 1st (D_3) followed by November 15th (D_4) and Significantly more number of days to flower initiation (41.46), days to 50 % flowering (59.51), less pollen viability (45.17 %), pollen germination (46.42 %) chlorophyll content (51.89 and 54.29) and dry matter accumulation (2.70 and 6.75 g) @ 40 and 60 days after planting was recorded in December 1st (D_5). Similar trend was followed during the individual years of 2015-16 and 2016-17.

Application of foliar nutrition (T):

The pooled data revealed that, all the physiological parameters varied markedly due to foliar application of nutrition over the dates of bulb planting. Micronutrient mixture at 0.25 % (T_3) recorded significantly less number of days to flower initiation (39.01), days to 50 % flowering (57.71), more pollen viability (74.36 %), pollen germination (59.59 %) chlorophyll content (61.60 and 64.94) and dry matter accumulation (3.54 and 7.48 g) @ 40 and 60 days after planting which was on par with T_1 and Significantly more number of days to flower initiation (41.13), days to 50 % flowering (59.19), less pollen viability (54.87 %), pollen germination (43.86 %) chlorophyll content (55.17 and 57.01) and dry matter accumulation (2.92 and 6.68 g) @ 40 and 60 days after planting was recorded in control (T_4). Similar trend was followed during the individual years of 2015-16 and 2016-17.

Interaction (D x T)

The interaction effect of dates of bulb planting and foliar application of nutrition, (D x T) was found statistically significant in the pooled data as well as during 2015-16 and 2016-17 experiments. Significantly it was lowest in pooled data in D_3T_3 (November 1st and micronutrient mixture at 0.25 %) interaction in days to flower initiation (37.71), days to 50 % flowering (55.77), more pollen viability (87.23 %), pollen germination (70.07 %) chlorophyll content (69.50 and 72.50) and dry matter accumulation (5.03 and 8.52 g) @ 40 and 60 days after planting and Significantly more number of days to flower initiation (40.88), days to 50 % flowering (58.93), less pollen viability (45.67 %), pollen germination (46.77 %) chlorophyll content (48.33 and 47.40) and dry matter accumulation (2.50 and 5.92 g) @ 40 and 60 days after planting was recorded in December 1st and control (D_5T_4) interaction. Similar trend was followed during the individual years of 2015-16 and 2016-17.

It might be due to early planting at October 1st registered slightly more number of days to flower initiation and 50 per cent flowering due to availability of night cool temperature at respective planting dates. The present results are in confirmative with Khalid *et al*., 2007 in onion who observed days to flower initiation and more bolting in the temperature range of 9-13 ^{o}C but which was slightly higher in the present study (11-15 ^{o}C) and luxuriant vegetative growth which resulted in the increased number of leaves causing efficient photosynthetic activity as evidenced by higher chlorophyll content (66.78). Delayed flowering in delayed December 1st planting hastened reproductive phase faster due to stress conditions like high temperature, atmospheric drought and receding soil moisture, *etc*. which compared to November 1st planting. The similar trend was also seen in the 2015-16 and 2016-17 experiments. These results are in agreement with findings of Balraj *et al*[3]., and Anisuzzaman *et al*[1]., in onion.

In the five dates of planting and foliar application significantly more chlorophyll content (SPAD value) and dry matter accumulation at 40 and 60 DAP (Table 1 and 7). It might be related to better vegetative growth, plant canopy and efficient photosynthetic activity which might have enhanced the reproductive growth in November planting and the existence of congenial weather enhanced photosynthetic activity and better assimilation, translocation of photosynthetic from source to reproductive entities (flower and seeds) due to increased accumulation of carbohydrates, proteins, amino acids and enzymes. Further, the

existence of favourable conditions in November month might have enhanced same.

The favourable effect of micronutrients on plant growth might be due to their role in many physiological process and cellular functions within the plants. In addition, they play an essential role in improving plant growth, through biosynthesis of endogenous hormones which are responsible for promoting of plant growth. From the above results, it can be concluded that, foliar application of boron and zinc @ 0.5 % significantly enhance growth, yield and quality of onion in the New Alluvial Zone of West Bengal[6]. Zinc and boron play an essential role in improving plant growth, through the biosynthesis of endogenous hormones which is responsible for promotion of plant growth. Increase in the number of leaves per plant may also be attributed due to the role of micronutrients (Zn, B) in cell division, meristematic acticity of plant tissue and expansion of cells. These treatments enhancing the days for flowering parameters which may be attributed to the continuous availability of both major and micro nutrients through foliar feeding causing the increased vegetative growth parameters and enhanced final harvest period. The present findings are in agreement with those of Davis *et al*[5]., in tomato; Basavarajeswari *et al*[4]., in tomato.

Table 1: Effect of dates of bulb planting and application of foliar nutrition on days to flower initiation and days to 50 per cent flowering in onion cv. Arka Kalyan

Treatment	Days to flower initiation			Days to 50 % flowering		
Planting time (D)	**2015-16**	**2016-17**	**Pooled**	**2015-16**	**2016-17**	**Pooled**
D_1 : OCT-1st	40.67	40.22	**40.44**	59.24	57.76	**58.50**
D_2 : OCT-15th	41.46	41.01	**41.23**	60.03	58.55	**59.29**
D_3 : NOV-1st	39.22	38.79	**39.01**	57.79	56.33	**57.06**
D_4 : NOV-15th	39.78	39.28	**39.53**	58.35	56.82	**57.59**
D5: DEC-1st	41.76	41.16	**41.46**	60.33	58.70	**59.51**
S.Em±	**0.25**	**0.29**	**0.26**	**0.25**	**0.29**	**0.26**
C.D. (P=0.05)	**0.72**	**0.83**	**0.76**	**0.72**	**0.83**	**0.76**
Application of foliar nutrition (T)						
T_1 : Borax @ 0.25 %	40.43	40.06	**40.24**	59.00	57.60	**58.30**
T_2: Potassium nitrate @ 0.5 %	40.49	40.12	**40.31**	59.06	57.66	**58.36**
T_3: Micronutrient mixture @0.25%	39.99	39.32	**39.66**	58.56	56.86	**57.71**
T_4 :Control	41.40	40.86	**41.13**	59.97	58.40	**59.19**
S.Em±	**0.23**	**0.26**	**0.24**	**0.23**	**0.26**	**0.24**
C.D. (P=0.05)	**0.64**	**0.74**	**0.68**	**0.64**	**0.74**	**0.68**
Interactions (D x T)						
D_1T_1	40.83	40.46	**40.65**	59.40	58.00	**58.70**
D_1T_2	40.67	40.30	**40.48**	59.24	57.84	**58.54**
D_1T_3	40.18	39.48	**39.83**	58.75	57.02	**57.89**
D_1T_4	41.00	40.63	**40.82**	59.57	58.17	**58.87**
D_2T_1	41.63	41.26	**41.45**	60.20	58.80	**59.50**
D_2T_2	41.50	41.13	**41.32**	60.07	58.67	**59.37**
D_2T_3	41.02	40.65	**40.83**	59.59	58.19	**58.89**
D_2T_4	41.68	41.00	**41.34**	60.25	58.54	**59.40**
D_3T_1	38.17	37.80	**37.98**	56.74	55.34	**56.04**
D_3T_2	38.70	38.33	**38.52**	57.27	55.87	**56.57**
D_3T_3	38.00	37.42	**37.71**	56.57	54.96	**55.77**
D_3T_4	42.00	41.63	**41.82**	60.57	59.17	**59.87**
D_4T_1	39.50	39.13	**39.32**	58.07	56.67	**57.37**
D_4T_2	39.67	39.30	**39.48**	58.24	56.84	**57.54**
D_4T_3	38.97	38.05	**38.51**	57.54	55.59	**56.57**
D_4T_4	41.00	40.63	**40.82**	59.57	58.17	**58.87**
D_5T_1	42.00	41.63	**41.82**	60.57	59.17	**59.87**
D_5T_2	41.93	41.56	**41.75**	60.50	59.10	**59.80**
D_5T_3	41.77	41.02	**41.39**	60.34	58.56	**59.45**
D_5T_4	41.33	40.42	**40.88**	59.90	57.96	**58.93**
S.Em±	**0.50**	**0.58**	**0.53**	**0.50**	**0.58**	**0.53**
C.D. (P=0.05)	**1.44**	**1.65**	**1.52**	**1.44**	**1.65**	**1.52**

Table 2: Effect of dates of bulb planting and application of foliar nutrition on pollen viability and pollen germination (%) in onion cv. Arka Kalyan

Treatment	Pollen viability (%)			Pollen germination (%)		
Planting time (D)	**2015-16**	**2016-17**	**Pooled**	**2015-16**	**2016-17**	**Pooled**
D_1 : OCT-1st	70.25	72.05	**71.15**	50.25	53.43	**51.84**
D_2 : OCT-15th	67.22	69.02	**68.12**	52.22	55.22	**53.72**
D_3 : NOV-1st	78.50	79.85	**79.18**	59.83	62.68	**61.26**
D_4 : NOV-15th	74.04	75.39	**74.72**	54.04	56.94	**55.49**
D5: DEC-1st	45.17	45.17	**45.17**	45.17	47.67	**46.42**
S.Em±	**0.81**	**0.82**	**0.81**	**0.81**	**0.83**	**0.82**
C.D. (P=0.05)	**2.33**	**2.34**	**2.33**	**2.31**	**2.39**	**2.34**
Application of foliar nutrition (T)						
T_1 : Borax @ 0.25 %	70.60	72.04	**71.32**	54.93	57.69	**56.31**
T_2 : Potassium nitrate @ 0.5 %	69.57	70.65	**70.11**	53.83	56.61	**55.22**
T_3:Micronutrient mixture @0.25%	73.64	75.08	**74.36**	58.11	61.07	**59.59**
T_4 :Control	54.33	55.41	**54.87**	42.33	45.39	**43.86**
S.Em±	**0.73**	**0.73**	**0.73**	**0.72**	**0.75**	**0.73**
C.D. (P=0.05)	**2.08**	**2.09**	**2.09**	**2.07**	**2.14**	**2.09**
Interactions (D x T)						
D_1T_1	71.67	73.47	**72.57**	51.67	54.87	**53.27**
D_1T_2	73.33	75.13	**74.23**	53.33	56.13	**54.73**
D_1T_3	79.33	81.13	**80.23**	59.33	62.13	**60.73**
D_1T_4	56.67	58.47	**57.57**	36.67	40.60	**38.63**
D_2T_1	70.00	71.80	**70.90**	50.00	52.80	**51.40**
D_2T_2	66.67	68.47	**67.57**	46.67	49.87	**48.27**
D_2T_3	76.20	78.00	**77.10**	56.20	59.40	**57.80**
D_2T_4	56.00	57.80	**56.90**	56.00	58.80	**57.40**
D_3T_1	85.00	86.80	**85.90**	66.67	69.47	**68.07**
D_3T_2	84.33	84.33	**84.33**	65.67	67.93	**66.80**
D_3T_3	86.33	88.13	**87.23**	68.67	71.47	**70.07**
D_3T_4	58.33	60.13	**59.23**	38.33	41.87	**40.10**
D_4T_1	79.33	81.13	**80.23**	59.33	62.13	**60.73**
D_4T_2	78.17	79.97	**79.07**	58.17	60.97	**59.57**
D_4T_3	83.67	85.47	**84.57**	63.67	66.87	**65.27**
D_4T_4	55.00	55.00	**55.00**	35.00	37.80	**36.40**
D_5T_1	47.00	47.00	**47.00**	47.00	49.20	**48.10**
D_5T_2	45.33	45.33	**45.33**	45.33	48.13	**46.73**
D_5T_3	42.67	42.67	**42.67**	42.67	45.47	**44.07**
D_5T_4	45.67	45.67	**45.67**	45.67	47.87	**46.77**
S.Em±	**1.63**	**1.63**	**1.63**	**1.61**	**1.67**	**1.63**
C.D. (P=0.05)	**4.66**	**4.68**	**4.66**	**4.62**	**4.78**	**4.68**

Table 3: Effect of dates of bulb planting and application of foliar nutrition on chlorophyll content (SPAD value) at 40 and 60 DAP in onion cv. Arka Kalyan

Treatment	Chlorophyll content @ 40 DAP			Chlorophyll content @ 60 DAP		
Planting time (D)	**2015-16**	**2016-17**	**Pooled**	**2016-17**	**2015-16**	**Pooled**
D_1 : OCT-1st	58.41	60.93	**59.67**	62.68	62.78	**62.73**
D_2 : OCT-15th	54.88	58.20	**56.54**	59.15	60.53	**59.84**
D_3 : NOV-1st	62.13	64.69	**63.41**	66.69	66.87	**66.78**
D_4 : NOV-15th	61.29	62.93	**62.11**	64.45	65.73	**65.09**
D5: DEC-1st	50.83	52.95	**51.89**	54.45	54.12	**54.29**
S.Em±	**0.99**	**0.85**	**0.87**	**0.87**	**0.94**	**0.84**
C.D. (P=0.05)	**2.85**	**2.43**	**2.49**	**2.48**	**2.68**	**2.39**
Application of foliar nutrition (T)						
T_1 : Borax @ 0.25 %	57.15	58.88	**58.01**	60.25	62.63	**61.44**
T_2 : Potassium nitrate @ 0.5 %	58.77	61.46	**60.11**	63.48	63.72	**63.60**
T_3:Micronutrient mixture @0.25%	60.42	62.79	**61.60**	64.77	65.11	**64.94**
T_4 :Control	53.70	56.64	**55.17**	57.45	56.56	**57.01**
S.Em±	**0.89**	**0.76**	**0.78**	**0.77**	**0.84**	**0.75**
C.D. (P=0.05)	**2.55**	**2.18**	**2.22**	**2.22**	**2.40**	**2.14**
Interactions (D x T)						
D_1T_1	57.87	60.37	**59.12**	62.14	63.25	**62.69**
D_1T_2	60.67	63.02	**61.84**	64.94	64.13	**64.53**
D_1T_3	61.43	63.78	**62.61**	65.70	64.69	**65.20**
D_1T_4	53.67	56.57	**55.12**	57.94	59.05	**58.49**
D_2T_1	55.20	58.43	**56.82**	59.47	60.58	**60.03**
D_2T_2	56.00	58.35	**57.18**	60.27	62.46	**61.37**
D_2T_3	58.33	60.68	**59.51**	62.60	63.71	**63.16**
D_2T_4	50.00	55.33	**52.67**	54.27	55.38	**54.83**
D_3T_1	60.17	62.52	**61.34**	64.44	65.55	**64.99**
D_3T_2	66.67	68.33	**67.50**	71.73	70.67	**71.20**
D_3T_3	68.33	70.67	**69.50**	73.00	72.00	**72.50**
D_3T_4	53.33	57.23	**55.28**	57.60	59.25	**58.43**
D_4T_1	63.50	60.28	**61.89**	61.92	68.88	**65.40**
D_4T_2	58.17	62.90	**60.53**	63.85	63.63	**63.74**
D_4T_3	60.33	62.78	**61.56**	64.60	66.09	**65.35**
D_4T_4	63.17	65.73	**64.45**	67.44	64.33	**65.89**
D_5T_1	49.00	52.78	**50.89**	53.27	54.92	**54.10**
D_5T_2	52.33	54.68	**53.51**	56.60	57.71	**57.16**
D_5T_3	53.67	56.02	**54.84**	57.94	59.05	**58.49**
D_5T_4	48.33	48.33	**48.33**	50.00	44.79	**47.40**
S.Em±	**1.99**	**1.70**	**1.74**	**1.73**	**1.87**	**1.67**
C.D. (P=0.05)	**5.69**	**4.86**	**4.97**	**4.95**	**5.37**	**4.78**

Table 4: Effect of dates of bulb planting and application of foliar nutrition on dry matter content of leaves at 40 and 60 DAP in onion cv. Arka Kalyan

Treatment	Dry matter content @ 40 DAP			Dry matter content @ 60 DAP		
Planting time (D)	**2015-16**	**2016-17**	**Pooled**	**2016-17**	**2015-16**	**Pooled**
D_1 : OCT-1st	2.63	3.72	**3.18**	6.64	7.43	**7.04**
D_2 : OCT-15th	2.43	3.37	**2.90**	6.37	7.25	**6.81**
D_3 : NOV-1st	3.75	4.71	**4.23**	7.60	7.73	**7.66**
D_4 : NOV-15th	2.72	3.84	**3.28**	7.01	7.56	**7.28**
D5: DEC-1st	2.23	3.18	**2.70**	6.28	7.23	**6.75**
S.Em±	**0.10**	**0.10**	**0.09**	**0.14**	**0.10**	**0.11**
C.D. (P=0.05)	**0.30**	**0.29**	**0.25**	**0.41**	**0.27**	**0.31**
Application of foliar nutrition (T)						
T_1 : Borax @ 0.25 %	2.79	3.63	**3.21**	6.74	7.31	**7.03**
T_2 : Potassium nitrate @ 0.5 %	2.82	3.90	**3.36**	6.88	7.63	**7.25**
T_3:Micronutrient mixture @0.25%	2.99	4.08	**3.54**	7.15	7.81	**7.48**
T_4 :Control	2.40	3.44	**2.92**	6.35	7.01	**6.68**
S.Em±	**0.09**	**0.09**	**0.08**	**0.13**	**0.09**	**0.10**
C.D. (P=0.05)	**0.27**	**0.26**	**0.23**	**0.37**	**0.24**	**0.28**
Interactions (D x T)						
D_1T_1	2.63	3.47	**3.05**	6.67	7.35	**7.01**
D_1T_2	2.96	3.97	**3.47**	6.96	7.47	**7.21**
D_1T_3	2.58	3.67	**3.13**	6.58	7.55	**7.07**
D_1T_4	2.35	3.77	**3.06**	6.35	7.37	**6.86**
D_2T_1	2.51	3.25	**2.88**	6.28	7.25	**6.77**
D_2T_2	2.30	3.32	**2.81**	6.30	7.32	**6.81**
D_2T_3	2.37	4.00	**3.18**	6.36	7.35	**6.86**
D_2T_4	2.53	2.92	**2.73**	6.53	7.08	**6.81**
D_3T_1	3.87	4.50	**4.18**	7.17	7.17	**7.17**
D_3T_2	4.00	5.07	**4.53**	8.00	8.33	**8.17**
D_3T_3	4.57	5.50	**5.03**	8.47	8.57	**8.52**
D_3T_4	2.58	3.76	**3.17**	6.75	6.83	**6.79**
D_4T_1	2.60	3.60	**3.10**	7.17	7.47	**7.32**
D_4T_2	2.67	4.00	**3.33**	7.00	7.81	**7.41**
D_4T_3	3.03	4.03	**3.53**	7.10	7.70	**7.40**
D_4T_4	2.56	3.73	**3.14**	6.78	7.24	**7.01**
D_5T_1	2.33	3.33	**2.83**	6.40	7.33	**6.87**
D_5T_2	2.17	3.17	**2.67**	6.15	7.20	**6.68**
D_5T_3	2.40	3.20	**2.80**	7.23	7.87	**7.55**
D_5T_4	2.00	3.00	**2.50**	5.33	6.50	**5.92**
S.Em±	**0.21**	**0.20**	**0.18**	**0.29**	**0.19**	**0.22**
C.D. (P=0.05)	**0.60**	**0.57**	**0.51**	**0.82**	**0.55**	**0.63**

CONCLUSION

In order to achieve higher seed yield and quality, physiological parameters played very effective role in onion Cv. Arka Kalyan by bulb planting in the month of November first coupled with further spraying of micronutrient mixture at (0.25 %) over the control.

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