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Community Small Onion / Multiplier Onion (*Allium cepa* var *aggregatum*) Nursery as a Contingency Measure for Delayed Planting in NICRA Village of Namakkal District, Tamil Nadu, India

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A B S T R A C T

Vadavathur in Namakkal District is a drought prone village. The annual rainfall is 400 mm. In Vadavathur village, small onion is cultivated in two main seasons *viz.*, Early kharif (May – August) and Rabi (November – December). Generally small onion is propagated by means of bulbs. However, NICRA village Vadavathur experienced aberrant rainfall situations with minimum rainy days for the past 5 years during sowing season especially during Rabi impacting adversely small onion production and livelihood of farmers. It appears that failure of rain and prolonged dry spells in November – December is responsible, as sowing of small onion is delayed with resultant adverse affect on productivity. Delay in sowing of small onion affects productivity in terms of delayed sprouting, slow growth of vegetative phase and reduction in yield. To mitigate these problems, KVK, Namakkal established staggered community small onion var. Co (On) 5 nursery during October in an area of 0.4 ha covering 20 farmers as a local adaptation strategy at the village level to combat the problem experienced by farmers during deficit rainfall seasons. Majority of the farmers could take up transplanting using seedlings from the 1st and 2nd nursery raised on 1st and 15th October. Highest bulb yield of 77 gm/plant, 22.3 tonnes /ha and benefit cost ratio of 3.4 was obtained by transplanting of onion seedlings which coincides with rainy days during November when compared to bulbs directly sown during December.

Introduction

Small onion / Multiplier onion, *Allium cepa var.aggregatum* L is one of the most important commercial vegetable and spice crops. The area under multiplier onion is being increased in India especially in Tamil Nadu. The total area under onion in Tamil Nadu is 4.01 lakh hectares with a production of 47.27 lakh tonnes (Anon 2014). The study area of Vadavathur village, Erumapatti block, Namakkal District, Tamil Nadu is a drought prone village. The annual rainfall is 400 mm; hence this village was selected to implement

the National Initiative on Climate Resilient Agriculture (NICRA) Project during the year 2010. The main climatic vulnerability faced by NICRA farmers is drought. The total area and productivity of small onion under Namakkal district was 1,997 ha and 12 t / ha, respectively. In Vadavathur village, small onion is cultivated in two main seasons *viz.*, Early kharif (May –August) and Rabi (November – December) in an area of 425 ha. However, NICRA village Vadavathur experienced aberrant rainfall situations with minimum rainy days for the past 5 years during sowing season especially during Rabi impacting adversely small onion production and livelihood of farmers. It appears that failure of rain and prolonged dry spells in November – December, as sowing of small onion is delayed which resultant adverse affect on productivity. Delay in sowing of small onion affects productivity in terms of delayed sprouting, slow growth of vegetative phase and reduction in yield. The existing practice has led to use of high seed rate (Totally 12.5 – 15.0 q of seed bulb is required for small onion cultivation in an area of 1 hectare), high cost involved for seed purpose (Rs. 25000 – 30,000 / ha) and also timely sowing during rainy season due to deficit rainfall. To mitigate these problems, farmers' preferred low seed rate variety which withstand drought during bulbing stage, ready availability of seedlings for transplanting at the time of rainy period to establish quickly with minimum rains is overwhelming and often wait for transplanting in rainfed areas till end of December in anticipation of rains.

Krishi Vigyan Kendra, Namakkal has introduced seed propagated small onion variety Co (On) 5. CO (On) 5 was developed by Tamil Nadu Agricultural University (TNAU), Coimbatore. It is a high yielding variety developed by mass pedigree method of selection. This variety has the ability of free flowering and seed set throughout Tamil Nadu. It possesses high bulb yield 18.9 t/ha (18.8 per cent higher than CO 4) in a crop duration of 90 days. It is free flowering type with seed setting ability of 250-300 kg/ha and so it is propagated through seeds (Saraswathi *et al.,* 2017). The seed rate required is 2.5 kg / ha. The objective of the study was to reduce risk in small onion cultivation during drought period by establishing community nursery in a staggered manner.

Materials and Methods

Brief description about NICRA village

The demonstrations were carried out at twenty famers' field of Vadavathur village of Namakkal District of Tamil Nadu during Rabi season 2013 -14, 2014 – 15 and 2015 -16. In this village small onion is cultivated in an area of 425 ha. Vadavathur is situated at 11.9241^0 N latitude and 78.11917^0 E longitudes and at an elevation of 531m above mean sea level. Based on 20 years weather data, it received an average rainfall of 400 mm annually, spreading over an average of 32 days in a year. The soil type is red sandy loam with a pH of 7.9 and EC of 0.064 dSm^{-1} with a soil nutrient status of low Nitrogen (188 kg/ ha), medium Phosphorus (11 kg / ha) and high Potassium (294 kg /ha).

Existing practice

In Vadavathur village, small onion is cultivated in two main seasons *viz.*, Early kharif (May –August) and Rabi (November – December). The kharif crop is mainly used for seed purpose for raising next crop whereas the Rabi crop was used for vegetable purpose. CO 4 and Valayapatti local is the predominant variety cultivated at Vadavathur. Generally small onion is propagated by means of bulbs. However, NICRA village Vadavathur experienced aberrant rainfall situations (Table 1; Fig. 1 and 2) with minimum rainy days

(Fig. 3) for the past 5 years during sowing season especially during Rabi (95 mm in 2011, 2 mm in 2012, 61 mm in 2013, 69 mm in 2014 and 100.5 mm in 2015) impacting adversely small onion production and livelihood of farmers. It appears that failure of rain (9 rainy days in 2011, no rainy days in 2012, 5 rainy days in 2013, 7 rainy days in 2014 and 8 rainy days in 2015) and prolonged dry spells (Table 2, Fig. 4) in November – December (41 days in 2011, 61 days in 2012, 36 days in 2013, 45 days in 2014 and 33 days in 2015) is responsible, as sowing of small onion is delayed with resultant adverse affect on productivity.

Delay in sowing of small onion affects productivity in terms of delayed sprouting, slow growth of vegetative phase and reduction in yield. The existing practice has led to use of high seed rate (Totally 12.5 – 15.0 q of medium sized seed bulb is required for small onion cultivation in an area of 1 hectare), high cost involved for seed purpose (Rs. 25000 – 30,000 / ha) and also timely sowing during rainy season due to deficit rainfall. To mitigate these problems, farmers' preferred low seed rate varieties which withstand drought during bulbing stage, ready availability of seedlings for transplanting at the time of rainy period to establish quickly with minimum rains is overwhelming and often wait for transplanting in rainfed areas till end of December in anticipation of rains.

Resilient practice/Technology intervention by KVK, Namakkal

Establishment of community small onion nursery

Establishing a staggered community small onion var. Co (On) 5 nurseries was explored as a local adaptation strategy at the village level to combat the problem experienced by farmers during deficit rainfall seasons. The technique involves raising a staggered community nursery under assured irrigation in the village at an interval of 2 weeks. In the anticipation of a two weeks delay in monsoon the first nursery is taken up as a contingency measure with low seed rate (2.5 kg / ha) variety Co(On) 5 by 1st October in order to transplant 40 days old seedlings by first fortnight of November. If the monsoon delay extends by 4 weeks, the second nursery is raised by 15th October to supply 40 days old seedlings for transplanting in the 3rd or 4th week of November. In case of anticipation of further delay or deficit rainfall conditions, the 3rd nursery is raised by 1st week of November to take up transplanting during first fortnight of December. The experiment was laid out in Randomized Block Design (RBD) with three replications at NICRA village of Namakkal District.

Nursery management of small onion variety. Co (On) 5

Raised bed nursery was formed with a size of 70 -75 cm breadth, 15 cm height and 3 – 5 m length during first week of October 2014. Totally one cent area was required to raise seedling for one hectare. Well decomposed farmyard manure @ 10 kg/sq.m and 1kg neem cake was applied to the nursery bed after the removal of stones and weeds. Seeds were treated with 4 g of *Trichoderma viride* and 10 g of *Pseudomonas fluorescence* 12 hours before sowing to prevent the seed borne diseases *viz*., basal rot and damping off.

Treated seeds were sown in line with 1 cm depth formed at 5 cm interval on the raised bed and was mulched with coconut fronds / paddy straw, which was used to maintain the temperature and moisture required for onion seed germination. Irrigation was given through rose can after mulching and was done daily up to 40 days after sowing. The seeds germinated five days after sowing, thereafter

the mulch material was removed. Five days after germination, *Trichoderma viride* @ 100 gm was applied along with 25 kg of farm yard manure per nursery bed to prevent the damping of disease in seedling stage. Hand weeding was done at 10 days interval. Forty days after sowing, the seedlings were pulled out from nursery bed for transplanting.

Transplanting of seedlings

Irrigation was applied one day prior to transplanting. Forty days old healthy seedlings (Table 3) of aggregatum onion cv. Co (On) 5 were transplanted in the flat beds at a distance of 15 x 10 cm during 1st fortnight of November (Table 3). Fifteen days before transplanting, 100 kg of well powdered and decomposed farmyard manure enriched with each one kg of *Trichoderma viride* and *Pseudomonas fluorescence* was applied to prevent basal rot in the field. At the time of transplanting 65 kg of urea, 375 kg of super phosphate and 50 kg of potash was applied as a basal manuring per ha area. Five days after transplanting, maize as a barrier crop (NK 6240) was sown around the field and ridges at a spacing of 1 ft, to prevent the entry of thrips from the neighbouring fields. Thereafter, blue sticky traps were installed at 100 m interval with a total of 50 traps/ ha at one ft height above the onion plant to attract the thrips.

Top dressing of 65 kg of urea and 50 kg of potash was done at 30 days after transplanting. Irrigation was given just after transplanting and later on watering was done at seven day's interval. Foliar spray of zinc sulphate, ferrous sulphate and borax (each 3 g) was given at 30 and 45 days after transplanting. Monitoring and field visits were conducted regularly to collect feedback and provide solutions to the problems reported by the participating farmers. All the observations were recorded on randomly selected twenty five plants, except the yield (t/ha), which was computed based on the net plot yield.

Statistical analysis

Statistical analysis was performed as per methods suggested by Panse and Sukhatme (1985).

Results and Discussion

In Vadavathur village of Namakkal District, Tamil Nadu community small onion nursery with low seed rate and drought tolerant variety Co(on) 5 was taken up on 1st October (1st nursery), 15th October (2nd nursery) & 1st November (3rd nursery), respectively each in 5 farmers fields. During 2011 and 2012 Rabi season, KVK, Namakkal implemented this strategy and demonstrated the concept of community small onion nursery in Vadavthur village. 21 numbers of farmers adopted this technique and jointly produced seedlings to ensure timely transplanting of correct age seedlings for higher productivity and reduce the risk associated with deficit/delayed onset of monsoon. In 2012-13, this village experienced deficit rainfall situation in November and December. During Rabi 2013, 2014 and 2015 small onion nurseries were taken up by the community with staggered sowings on 1st October and 15th October could be used for transplanting in November after receipt of rain in an area of 20 ha. In 2014 -15 and 2015 -16, Community nursery was demonstrated on 0.4 ha covering 20 farmers. Majority of the farmers could take up transplanting using seedlings from the 1st and 2nd nursery raised on 1st and 15th October.

Growth parameters

Seedling height at 40 days after sowing was significantly influenced by climatic conditions prevailed in the particular region. Irrespective of the sowing time, it is explicit

from the perusal of the Table 3, that the seedling height (17.4 cm), leaf sheath diameter (1.01cm), number of leaf sheath (2.82), No. of roots (15.4) and root length (5.06 cm) of was recorded as growth parameters in small onion variety Co(On) 5 at 40 days after sowing. This might be due to optimum soil temperature, relative humidity and rainfall prevailed during the growth period of small onion variety Co (On)5. The results are in accordance with finding of Jilani (2004).

Bulb characters of small onion

It was obvious from the data presented in Table 4 indicate that the maximum equatorial diameter of compound bulb (5.02 cm), polar diameter of the compound bulb (4.69 cm) and weight of the compound bulb (19.9 gram) was recorded in Co (On) 5 variety when compared to Co4 variety, which recorded 4.29 cm,3.91 cm and 8.76 gram respectively. In the present study the bulbs which were directly planted during December were subjected to initial mild temperature of 22.71°C and when they entered the bulbing phase the temperature rose up to 31.07°C and there was further increase as the bulbs had been maturing. Low night temperature and high day temperature induced more bulb yield in December transplanted seedling. Mohanty (2002) have reported high bulb yield in early planting depending upon the location of experiment. It might be due to better source sink relationship and higher photosynthetic activity which would have improved due to timely availability of nutrients through applied nutrients by soil as well as foliar application hence, better harvest of sunlight. Similar results have been reported by Rohini and Paramaguru (2017) (Table 5).

Table.1 Rainfall data of NICRA village during Small onion cropping season from 2011 – 2015

Sl.No	Year	November	December	January	February	Rainy days	Total rainfall (mm)
1.	2011	95 mm	19 mm	1 mm	0	9	115 mm
2.	2012	2 mm	0	0	38 mm	2	40 mm
3.	2013	61 mm	38 mm	0	0	5	99 mm
4.	2014	69 mm	61 mm	0	0	7	130 mm
5.	2015	100.5 mm	0	0	0	8	100.5 mm

Table.2 Dry spells (in days) during cropping period from 2011 to 2015 at Vadavathur

Particulars	Year	Month (Cropping period)			
		November	December	January	February
Duration of dry spell	2011	16	25	31	29
	2012	30	31	31	14
	2013	17	19	31	28
	2014	18	27	31	28
	2015	2	31	31	29
Crop stage		Sowing of onion bulbs.	Sowing – sprouting of Onion	Vegetative stage	Bulbing stage

Table.3 Growth parameter of small onion var.Co(On)5

Field number	Seedling height (cm)	Leaf sheath diameter (cm)	Number of leaf sheath	No. of roots	Root length (cm)
1	14.83	0.93	2.67	13.00	3.20
2	17.97	0.83	2.67	15.67	4.37
3	20.00	0.93	2.67	17.00	6.80
4	15.30	1.07	3.00	14.67	4.90
5	17.23	0.83	3.00	17.67	4.50
6	15.30	0.93	3.00	15.00	6.83
7	16.40	1.00	2.67	15.67	3.67
8	18.57	1.17	3.33	13.33	4.97
9	17.87	0.90	2.67	15.00	4.73
10	18.10	0.90	3.00	18.00	6.17
11	17.67	0.90	2.67	16.00	5.53
12	17.23	0.97	2.67	17.33	5.17
13	19.40	1.30	2.67	15.67	5.37
14	17.13	1.30	3.00	14.33	4.90
15	18.00	1.13	2.67	13.00	4.77
Mean	**17.4**	**1.01**	**2.82**	**15.4**	**5.06**
SED	2.29	0.24	0.43	1.74	1.09
CD(p=05)	4.71	0.48	0.88	3.57	2.24

Table.4 Bulb characters of small onion variety Co4 vs Co (On) 5

Field Number	Equatorial diameter of compound bulb (cm)		Polar diameter of compound bulb (cm)		Weight of the compound bulb (g)	
	Co (On)5	Co4	Co (On)5	Co4	Co (On)5	Co4
1	4.93	4.47	4.40	3.86	18.93	8.17
2	4.87	4.23	4.65	3.81	25.57	8.53
3	5.27	4.30	4.94	3.96	16.30	8.73
4	4.97	4.37	4.80	4.01	17.37	8.90
5	5.03	4.27	4.78	3.96	16.67	8.63
6	5.10	4.27	4.83	3.84	19.47	8.47
7	4.93	4.30	4.59	3.85	20.37	8.57
8	5.07	4.43	4.61	3.89	19.43	8.67
9	4.83	4.17	4.71	4.01	20.20	8.67
10	5.13	4.30	4.48	3.95	19.10	9.10
11	5.03	4.33	4.67	3.83	20.23	9.17
12	4.90	4.37	4.83	3.97	20.97	8.70
13	5.23	4.30	4.66	4.00	22.30	8.77
14	5.00	4.17	4.79	3.94	20.83	8.93
15	5.00	4.13	4.70	3.91	21.07	9.40
Mean	**5.02**	**4.29**	**4.69**	**3.91**	**19.9**	**8.76**
SED	0.13	0.11	0.10	0.12	2.17	0.48
CD (p= 05)	0.28	0.24	0.21	0.25	4.46	0.98

Table.5 Yield parameters of small onion var.Co4 vs Co(On)5

Field Number	No.of compound bulb / kg		No.of bulblets/kg		Yield / Plant (g)	
	Co (On)5	Co4	Co (On)5	Co4	Co (On)5	Co4
1	24.33	42.67	77.67	94.33	68.23	23.67
2	24.00	43.00	78.33	91.00	72.97	23.33
3	24.00	45.33	77.00	92.00	75.40	23.57
4	23.00	44.67	76.33	89.00	74.33	22.13
5	22.33	42.33	76.33	89.33	74.20	23.73
6	23.00	45.67	76.67	89.33	75.97	23.10
7	22.67	44.33	77.33	88.33	77.57	24.07
8	25.00	43.33	78.33	89.33	76.77	24.33
9	24.00	43.00	74.67	89.00	78.73	23.87
10	24.33	44.00	73.67	89.33	77.00	25.43
11	24.67	42.33	74.00	87.67	78.83	26.13
12	25.33	42.67	73.67	87.00	80.50	25.33
13	24.33	43.33	75.33	87.33	79.73	24.77
14	24.67	44.33	73.67	87.33	82.93	26.33
15	23.67	45.33	75.33	89.00	83.00	26.27
Mean	**23.95**	**43.75**	**75.88**	**89.28**	**77.07**	**24.40**
SED	1.38	1.51	2.10	2.35	4.66	2.25
CD (p= 05)	2.84	3.10	4.31	4.82	9.56	4.62

Fig.1 Total rainy days of Vadavathur village during onion cropping season

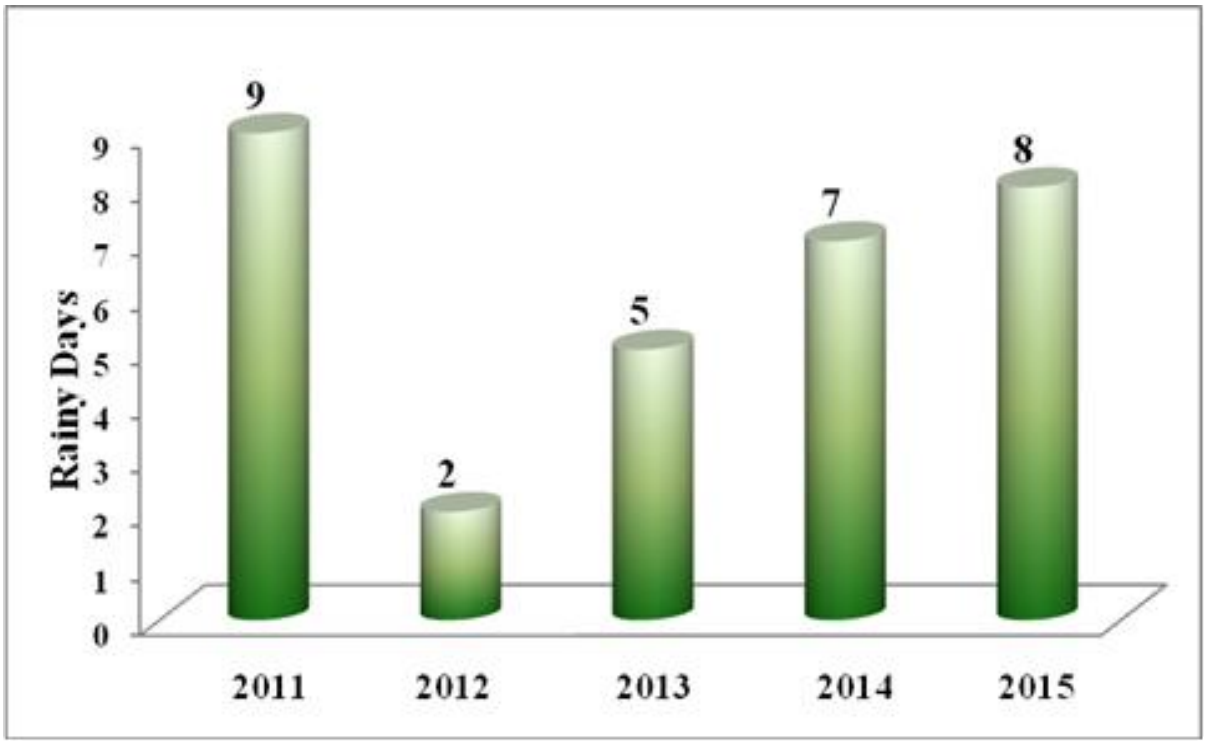


Fig.2 Total rainfall received at Vadavathur village during onion cropping season

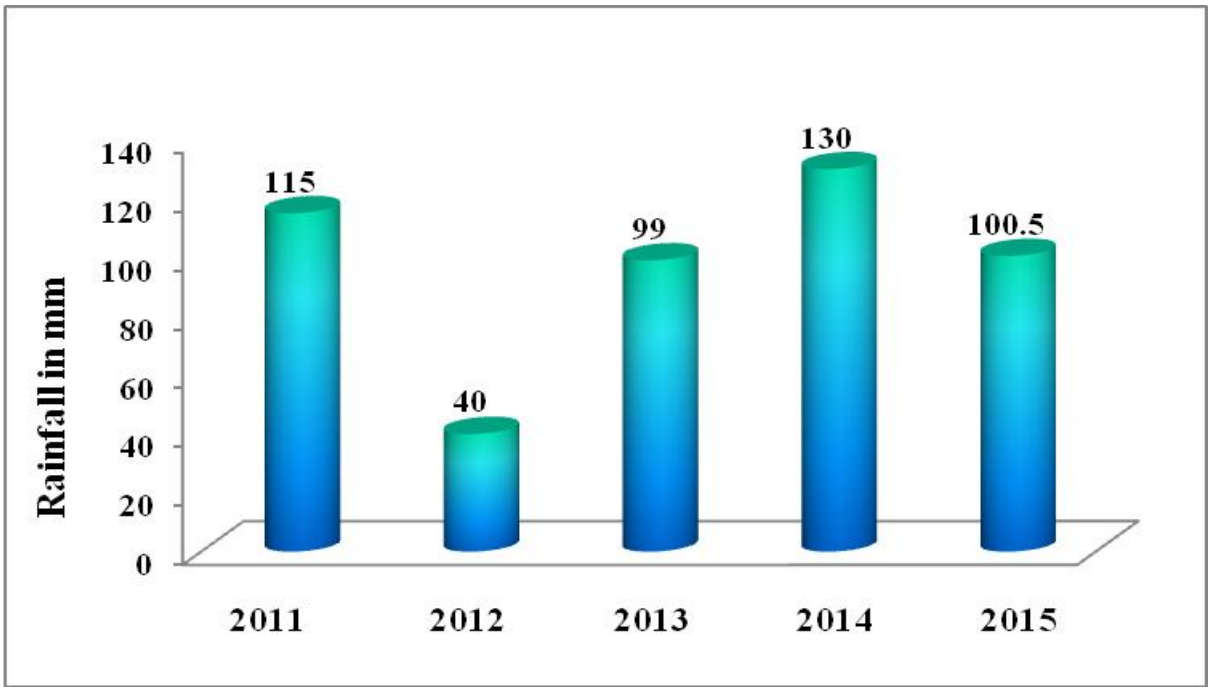
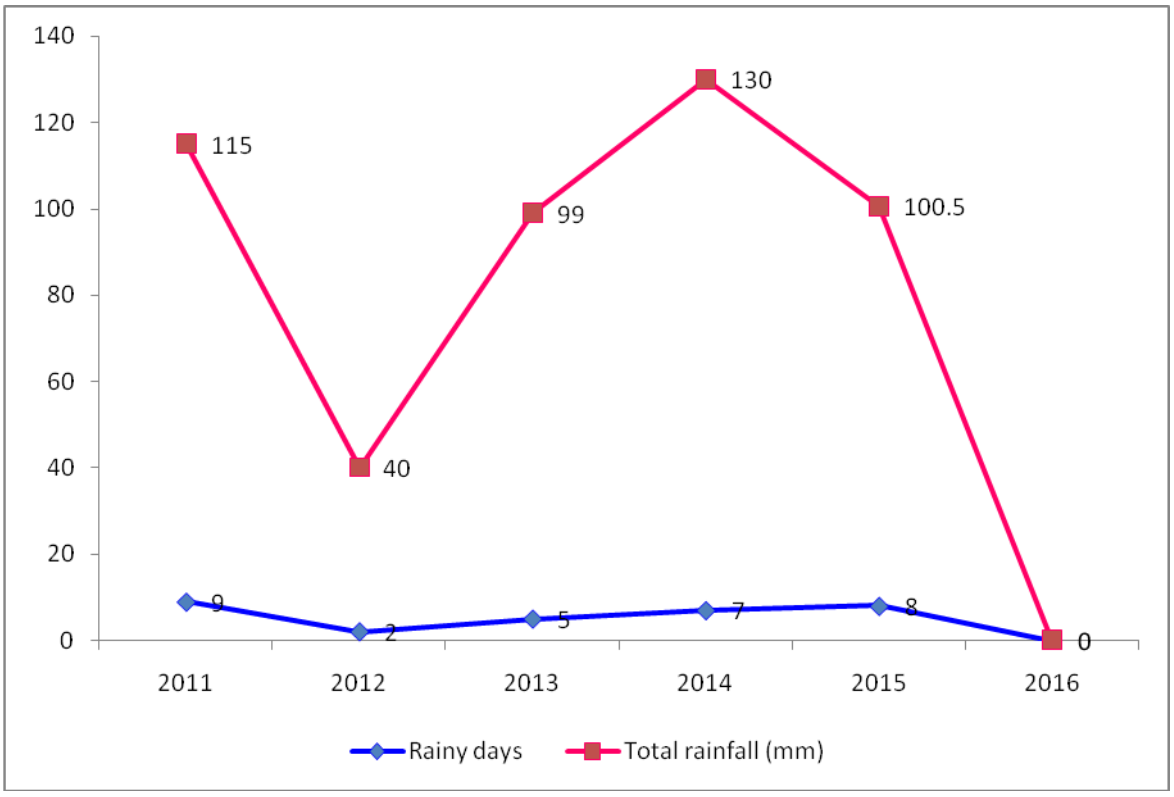
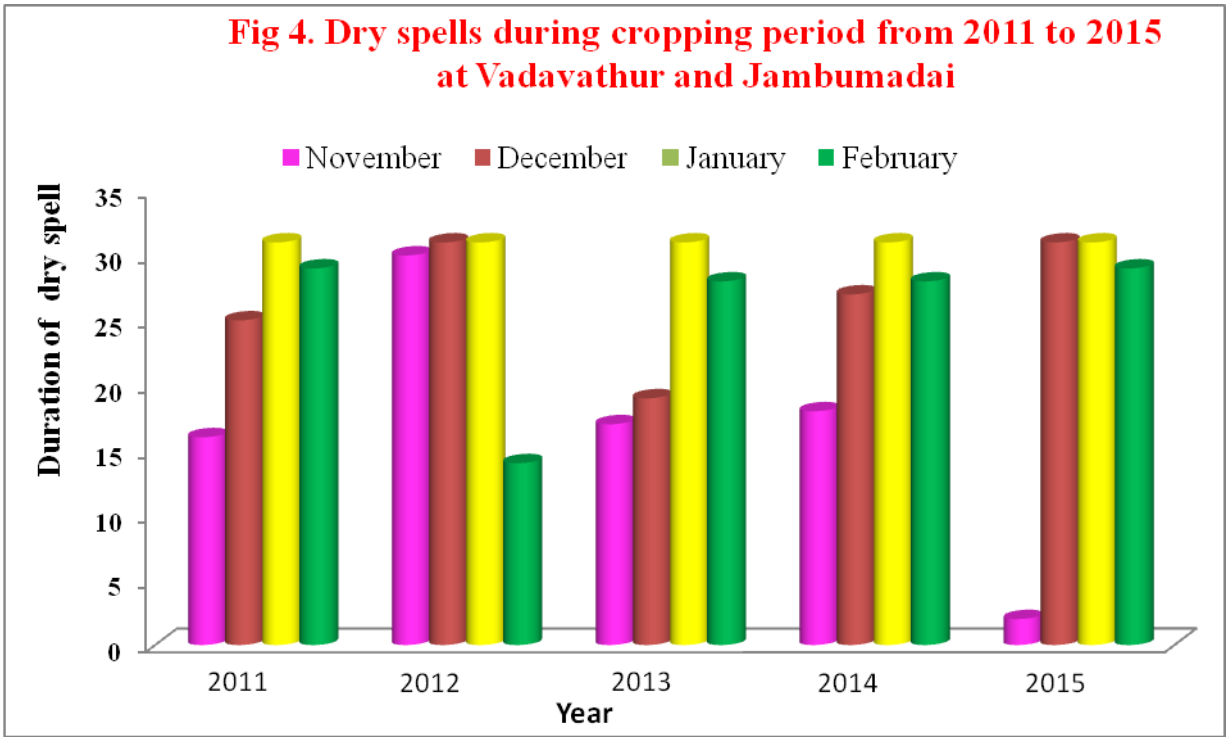


Fig.3 Total Rainfall and rainy days of Vadavthur village during onion cropping period from 2011 -2015





In addition to that application of micronutrients such as zinc and boron through soil or foliar or in combination had a beneficial effect on the growth of onion. This may be due to initial soil application and two foliar application of zinc sulphate.

Zinc is essential for tryptophan synthesis, which is a prerequisite for auxin formation, therefore amount of auxin decreases by zinc deficiency (Pedler *et al.*, 2000; Marschner, 1995; Cakmak *et al.*, 1989). This may be due to the improved growth characters as a result of foliar application of micronutrient which would have enhanced photosynthesis and other metabolic activities, which lead to increase in cell division and elongation (Hatwar *et al.*, 2003). This result is in agreement with Schmidt (1964); Katare *et al.*, (1971); Smriti *et al.*, (2002); Manna (2013) in onion.

The bulb yield/ plant (77.07 gram) was recorded under the treatment combination small onion variety Co(On)5 planted during Ist week of November. The lowest bulb yield/plant (24.40 gram) was obtained under small onion variety Co4 planted during 2nd fortnight of December. The findings of Ud-deen (2008) supported that increased yield may be because of difference in yield components as bulb volume, average weight of the bulbs and crop stand. Secondly it may be because of the seedlings planted early in the season getting established in field earlier. Consequently, early planting resulted in early continued swelling of the bulbs till the crop matured for harvesting. During late planting of Co4 variety of small onion the bulb size could not be developed which depended on temperature and day length. In this case the production assimilate would have been translocated towards developing sink (seeds) rather bulbs. In want of sufficient metabolites the bulbs remained underdeveloped.

The high yielding performance of onion variety Co (On) 5 at farmer's field was also reported by Umesh Acharaya *et al* (2015). Increase in bulb yield is mainly attributed to positive association between yield and yield contributing parameters like bulb weight and

size in terms of equatorial and polar diameter of the bulb and also the better management of thrips in the onion field through barrier crops and blue sticky traps. Thrips are weak fliers and can be carried by wind. Therefore, planting live- barriers like maize could effectively block adult thrips from reaching onion plants. Two rows of maize surrounding onion field blocks adult thrips up to 80 per cent and blue sticky traps attracted the thrips in the inside field up to 90 per cent (Srinivas and Lawande, 2006). This practice brings down insecticide application.

Extent of adoption and impact

These farmers' benefitted with an additional yield of 1.8 to 2 tonnes / ha (25 % increase in yield) compared to farmers who directly sown bulbs during December.

In Namakkal, State Department of Horticulture, Erumapatti block has supplied small onion var.Co(On) 5 seed under 50 % subsidy to NICRA village farmers for promoting farmer managed community nurseries under assured irrigation to make available onion seedlings for transplanting to meet contingent situations. Under this scheme, a community nursery in an area of 0.8 ha was raised and the seedlings were transplanted in 20 acres in 20 farmer's field in Vadavthur village.

Economics

The total cost of cultivation ranged from Rs.78,000 to Rs.87,306 / ha. Bulb yield obtained was in the range of 250 -275 bags/ ha (@ 81 kg/bag = 20.2 tonnes to 22.3 tonnes/ha) using 40 days old small onion seedlings of Co(On) 5 variety, which was raised in the month of 1st week of October. Highest net returns of Rs.3,03,750/- and benefit cost ratio of 3.4 was obtained by transplanting of onion seedlings which coincides with rainy days during November.

Upscaling

Community nursery was demonstrated in 2.8 ha covering 120 farmers in an area of 52.8 ha from 2011 to 2015 in Vadavathur village. Individual farmers or farmers group belonging to NICRA village are motivated to raise the onion seedlings and make availability during rainy season. Success stories of community nurseries as a contingency for delayed planting was presented in Farmers Grievance day meeting at District Collectorate and exposure visit of farmers made from various NICRA KVKs and Other KVKs (Perambalur, Karur, Villupuram, Dharwad, Dindigul, Ramanathapuram, Mysore, Alleppey) also visited this resilient practice.

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