***Original Research Article***

# Performance of Onion Seed crop under the soil amendments and fertilizers application in *Torripsamments*




## ABSTRACT

A field experiment was conducted at Aagricultural Research Station, Farm, SKRAU, Bikaner during *Rabi* 2021-22. The experiment was laid out in a split plot design involving four soil amendments *i.e.,* Control, 2 % canal silt, compost @ 30 t $ha^{-1}$and 2 %canal silt plus ccompost @ 30 t $ha^{-1}$ in main plot and four fertilizer levels *i.e.*, 0, 75, 100 and 125 % RDF in the sub plot with three replications.The results revealed that application of different soil amendments significantly increasedonion growth and yield attributes and found that maximum growth and yield attributes were recorded under 2 % canal silt with ccompost @ 30 t $ha^{-1}$.Itwas also observed that as the RDF increases, growth, yield, yield attributes, of onion during the onion seed crop production.


Key Woeds :- Canal Silt, Compost, Fertilizer, Onion Seed crop

## Introduction

Onions are used primarily as flavouring agents and their distinctive pungency and form essential ingredients for flavouring varieties of dishes, sauces, soup, sandwiches and snacks as onion rings etc, and which increase the taste of food (Rahim, 1992). The mature bulb contains some starch, appreciable quantities of sugars, some protein, and vitamins A, B, and C (Elhag and Osman, 2013; Opara, 2003). It is also one of the richest sources of flavonoid in the human diet and flavonoid consumption has been associated with a reduced risk of cancer, heart disease and diabetes. In addition, it is known for anti-bacterial, antiviral, anti-allergenic and anti-inflammatory potential and used as preservative and medicinal plant (MoARD, 2009).

The total onion production in the World in 2017 was 97.86 million tonnes, which was harvested in the area of 52.01 lakh ha, and the average yield was about 18.82 q per hac, out of which China is the leading country with production of 24.34 million tonnes (24.87% of total world production) in an area of 11.02 lakh ha, with a productivity of 22.1q per hac, followed by India (22.42 million tonnes), USA (3.72 million tonnes) and Iran (2.37 million tonnes) (Anonymous a, 2018). In Rajasthan total area is 64.76 thousand hectare and production 996.73 million tonnes (Anonymous b, 2018). In Bikaner total area is 692 hectare and production 830 tonnes (Anonymous c, 2018). Despite areas increase, the productivity of onion is much lower than other district. The low productivity could be attributed to the limited availability of quality seeds and associated production technologies used, among the others.

Canal silt have been found to improve moisture and nutrient status of sandy soil resulting in higher crop yield. The pond sediments are also applied in irrigation channels to check the seepage losses. Though in many small quantities, it reaches to cropped area and thus helps in improving the nutrient status of soil. The canal silt has higher nutritive value (Anonymous, 2003). Addition of canal silt to cultivated field improve the physico-chemical properties of the soil which results into good crop growth and higher yield (Kabir *et. al.* 1991). The application of canal silt improved the quality and productivity of marginal land and also suggested that the canal silt application will be a good option to bring marginal land under cultivation with improved productivity (Vaidya and Dhawan, 2013). The canal silt invariably is available free of cost to the farmers, except the cost for its transport. Application of sediments desilted from the tanka very shallow soil appears to be potentially viable option for returning the eroded fertile soil back to the field. Addition of large quantities of FYM and other organic residues can improve physical environment of these sandy soils. However, there is a general scarcity of such organic materials in the arid and semi-arid regions. Further, due to high temperature and excessive aeration, oxidation of added organic matter is very rapid and it is difficult to build-up organic matter reserves in such soils. Compost not only supplies a number of plant nutrient but also improves physico-chemical and biological properties of soil, which are major constraints in increasing the germination percentage and survival of emerging seedling in coarse textured soils (Kumar *et. al.*, 1996). Organically held plant nutrients play a vital role in sustaining plant nutrient availability and mineralization by maintaining optimum temperature, aeration and moisture, in the soil through compost. Compost with chemical fertilizer and their method of application helps in improving the fertility, productivity and physical condition of soil (Singh and Singh, 1965). The present study was therefore, carried out to determine the effects of soil amendments (Canal silt, compost and canal silt plus ccompost) and fertilizer levels on biochemical properties of soil in western Rajasthan, India.

## MATERIALS AND METHODS

### Experimental site

The experiment was conducted at the farm of Agricultural Research Station, SKRAU, Bikaner. The study area is situated in the state of Rajasthan and located on National Highway No. 15 leading towards Sriganganagar about 9 km away from Bikaner city. It is situated at $28^0$ 10' N latitude, $73^0$ 18' E longitude and 223.88 meter above mean sea level. The study area is situated in Agroclimatic zone Ic (Hyper arid partially irrigated western plain) of Rajasthan. The zone is characterized with extremes of hot in summer and cold in winter.

### Climate and weather conditions

Bikaner has arid climate with average annual rainfall of about 262 mm. More than 80 per cent of rainfall is received during *kharif* season (July-September) by the South West monsoon. During summer, the maximum temperature may go as high as 48 $^oC$ while in the winters it may fall as low as 0 $^oC$. The weather data was obtained from meteorological observatory of Agricultural Research Station, Bikaner.

### Soil of the experimental field

In order to know the physical and chemical properties of soil, the soil samples from 0-15 cm depth were drawn randomly from different spots of the experimental field and a representative composite sample was prepared. This composite sample was analyzed to determine the physico-chemical properties of the soil and find that soil have 8.58 pH,0.198 $dSm^{-1}$ electrical conductivity LoamySand in texture.

### Details of experiment and treatments

The experiment was laid out in split plot design with four soil amendments that is control, compost, canal silt and canal silt plus compost in main plot treatment and four levels of fertilizer in sup plot treatment and replicated thrice. The plan of layout has been given in table 2. The treatments were assigned to the experimental plots with the help of random number tables of Fisher (1950).

**Table 1: Details of treatments for experiments with symbols**

| | Treatments | Symbol |
|---|---|---|
| **I.** | **Main plot treatments** | |
| **A.** | **Soil amendments** | |
| I. | Control | ($A_0$) |
| II. | 2 % Canal silt | ($A_1$) |
| III. | Compost @ 30 t $ha^{-1}$ | ($A_2$) |
| IV. | 2 % Canal silt + Compost @ 30 t $ha^{-1}$ | ($A_3$) |
| **II.** | **Sub plot treatments** | |
| **B.** | **Fertilizer levels** | |
| I. | Control | ($F_0$) |
| II. | 75% recommended dose fertilizer | ($F_1$) |
| III. | 100% recommended dose fertilizer | ($F_2$) |
| IV. | 125% recommended dose fertilizer | ($F_3$) |

*Recommended dose of fertilizer (100kg $ha^{-1}$ N, 50 kg $ha^{-1}$ $P_2O_5$ and 100 kg $ha^{-1}$ $K_2O$)

**Treatment application**

Soil amendments *i.e.* compost, canal silt and canal silt plus compost were applied at 12 days before sowing compost applied @ 30 t $ha^{-1}$ and canal silt applied 2 % in the field.

Fertilizer was given through Urea (N), SSP (P) and MOP (K) in each plot as per treatment.

**Table 2 Details of the experiment as follows:**

| | |
|---|---|
| Season | *Rabi*, 2021-22 |
| Design | Split Plot Design |
| Total no. of treatments | |
| Main Plot | 4 |

| | |
|---|---|
| Sub Plot | 4 |
| Total no. of replications | 3 |
| Test crop | Onion seed crop |
| Total no. of plots | 48 |
| Row x plant spacing | 45 x 30 cm |
| Plot size | 3 m X 3 m |
| Seed rate | 30 q bulbs $ha^{-1}$ |
| Variety | Sikar local |
| Location | Main Farm ARS, Bikaner |

**Table 3: Average elemental composition of compost and canal silt**

| Element | Compost | Canal silt |
|---|---|---|
| Carbon (%) | 19.15 | 0.64 |
| Nitrogen | 0.78 % | 0.0092 % |
| Phosphorus | 0.29 % | 0.00095 % |
| Potassium | 0.39 % | 0.017 % |
| Iron (mg $kg^{-1}$) | 560 | 6.12 |
| Copper (mg $kg^{-1}$) | 4.7 | 11.3 |
| Zinc (mg $kg^{-1}$) | 37.5 | 1.18 |
| Manganese (mg $kg^{-1}$) | 67.36 | 11.5 |

**Growth attributing character**

Plant heightmeasured by five plants were selected at middle two rows from each plot Plant height was measured from the ground level to the top of the stalk in cm. diameter(cm) of umbels per plant were recorded already selected five plants with vernier caliper at 90 DAS of randomly selected five plants.The number of umbels $plant^{-1}$ were recorded already selected five plants at 90 DAS.A seed sample was taken from each plot and one thousand seeds were counted and weighed to record as test weight in grams.Onion seed crop were harvested threshed and weight of seed per umbel is measured after harvesting of selected five plants umbels and calculated average value.The weights of seed collected from the all umbels of each observational plant were summed up and mean seed yield per plant was calculated treatment wise.The weight of seeds collected from the observational plants as well as the remaining plants from the all plots were combined together, weighed and calculated on hectare basis.The weights of straw collected from the umbels of each observational plant were summed up and mean straw yield per plant was calculated treatment wise.The straw yield of each net plot was recorded in kg per plot and converted as q $ha^{-1}$.

**Economics of treatment**

Economics of the different treatments is the most important consideration for making any recommendation to the farmer for its wide implementation. For estimate economics of each treatment, the average treatment yield along with prevailing marketing cost for inputs and outputs were used. The gross return was computed by subtracting the cost of cultivation for each treatment from return achieved from economic yield.

Gross returns (Rs $ha^{-1}$) = Returns from onion seed (Rs $ha^{-1}$)

Net returns (Rs $ha^{-1}$) = Gross returns (Rs $ha^{-1}$) – Total cost of cultivation (Rs $ha^{-1}$).

**RESULTS**

**Effect of soil amendments**

The results indicated that plant height, umbels $plant^{-1}$, test weight, diameter of umbels, number of umbels $plant^{-1}$, number of seed $umbel^{-1}$, seed yield $plant^{-1}$, straw yield of onion seed crop was found to be influenced significantly with the application soil amendments. The highest above-mentioned growth and yield attributes were recorded with the incorporation 2 % canal silt with compost @ 30 t $ha^{-1}$followed by $A_2$ (Compost @ 30 t $ha^{-1}$) but it was at par with $A_1$ (2 % Canal silt). In the fertilizer levels revealed that plant height, umbels $plant^{-1}$, test weight, diameter of umbels, number of umbels $plant^{-1}$, number of seed $umbel^{-1}$, seed yield $plant^{-1}$, straw yield of onion seed crop was influenced significantly due to fertilizer levels. The highest growth and yield attributes were recorded with application of RDF @ 125 % followed by RDF @ 100 %, RDF @ 75 % and the lowest attributes were recorded in the control.

**Table 4 Effect of soil amendments and fertilizer levels on growth and yield attributes of onion seed crop**

| Treatments | Plant height (cm) at 90 DAS | Diameter of umbel (cm) at 90 DAS | No. of umbel plant$^{-1}$ at 90 DAS | Test weight (g) | No. of Seed umbel$^{-1}$ | Seed yield plant$^{-1}$ (g) | Dry matter plant$^{-1}$ (g) |
|---|---|---|---|---|---|---|---|
| **Soil amendments** | | | | | | | |
| $A_0$ - Control | 77.80 | 7.63 | 4.98 | 3.66 | 978.75 | 4.14 | 11.67 |
| $A_1$ - 2 % Canal silt | 85.29 | 8.69 | 7.34 | 3.67 | 1107.20 | 5.84 | 14.69 |
| $A_2$ - Compost @ 30 t ha$^{-1}$ | 90.57 | 9.26 | 7.89 | 3.69 | 1178.35 | 6.29 | 15.67 |
| $A_3$ - 2 % Canal silt + compost @ 30 t ha$^{-1}$ | 108.60 | 10.37 | 9.87 | 3.70 | 1334.95 | 7.11 | 19.88 |
| S.Em± | 1.91 | 0.17 | 0.31 | 0.05 | 21.81 | 0.14 | 0.96 |
| CD (0.05) | 6.593 | 0.58 | 1.08 | NS | 75.474 | 0.49 | 3.32 |
| **Fertilizer levels** | | | | | | | |
| $F_0$ - 0 % RDF | 71.93 | 7.93 | 6.15 | 3.66 | 974.35 | 4.79 | 12.04 |
| $F_1$ - 75 % RDF | 83.33 | 8.65 | 7.17 | 3.67 | 1117.95 | 5.66 | 15.29 |
| $F_2$ - 100 % RDF | 102.45 | 9.54 | 8.30 | 3.68 | 1234.95 | 6.25 | 16.79 |
| $F_3$ – 125 % RDF | 104.55 | 9.82 | 8.45 | 3.69 | 1272.00 | 6.68 | 17.79 |
| S.Em± | 1.27 | 0.11 | 0.30 | 0.07 | 14.28 | 0.19 | 0.51 |
| CD (0.05) | 3.71 | 0.32 | 0.88 | NS | 41.675 | 0.56 | 1.50 |

***Its value was average of five plants**

**Table 5 Effect of soil amendments and fertilizer levels on gross return and net return**

| Treatments | Yield | | Economics | |
|---|---|---|---|---|
| | **Seed yield ($q\ ha^{-1}$)** | **Dry matter ($q\ ha^{-1}$)** | **Gross return ($Rs\ ha^{-1}$)** | **Net return ($Rs\ ha^{-1}$)** |
| **Soil amendments** | | | | |
| $A_0$ - Control | 3.54 | 9.99 | 531194.44 | 461618.32 |
| $A_1$ - 2 % Canal silt | 4.99 | 12.57 | 749055.56 | 664396.19 |
| $A_2$ - Compost @ 30 t $ha^{-1}$ | 5.38 | 13.40 | 807375.00 | 677798.87 |
| $A_3$ - 2 % Canal silt + compost @ 30 t $ha^{-1}$ | 6.09 | 17.01 | 913000.00 | 768340.63 |
| S.Em± | 0.12 | 0.82 | 18079.40 | 18079.40 |
| CD (0.05) | 0.42 | 2.84 | 62562.97 | 62562.97 |
| **Fertilizer levels** | | | | |
| $F_0$ - 0 % RDF | 4.10 | 10.30 | 614361.11 | 511819.49 |
| $F_1$ - 75 % RDF | 4.84 | 13.08 | 726694.44 | 619576.79 |
| $F_2$ - 100 % RDF | 5.35 | 14.37 | 802138.89 | 693495.64 |
| $F_3$ – 125 % RDF | 5.72 | 15.22 | 857430.56 | 747262.10 |
| S.Em± | 0.16 | 0.44 | 24673.35 | 24673.35 |
| CD (0.05) | 0.48 | 1.28 | 72016.40 | 72016.40 |

**Effect of soil amendments and fertilizer levels on net returns**

It is evident from the experimental data mean basis presented in table 6 indicated that net returns of onion seed crop were significantly Increased by application of different soil amendments as compared to control. The maximum gross &net returns were recorded with the application of 2 % Canal silt with Compost @ 30 t $ha^{-1}$ which was significantly higher than Compost @ 30 t $ha^{-1}$ at par with $A_1$ (2 % Canal silt) and lowest gross &net returns were recorded under control.Perusal of data presented in table 6 indicated that net returns of onion seed crop was significantly influenced by application of different levels of RDF as compared to control. The highest gross &net returns were recorded with fertilizers application at 125 per cent followed by RDF @ 100 %, RDF @ 75 % and the lowest gross &net returns were recorded in the control.

**DISCUSSION**

**Growth, Yield attributes and yield of onion**

Application of compost @ 30 t $ha^{-1}$ significantly increased the plant height, diameter of umbels, number of umbels $plant^{-1}$, number of seed $umbel^{-1}$, seed yield (g $plant^{-1}$), seed yield (q $ha^{-1}$), dry matter yield (g $plant^{-1}$),dry matter yield (q $ha^{-1}$) of onion seed crop (Table 4 and 5). The application of compost @ 30 t $ha^{-1}$ along with 2 % canal silt recorded the maximum value of these parameters. This may be attributed primarily to the beneficial role of compost followed by canal silt which improved overall physical condition of the soil via in total pore space, water retention capacity and improvement in retention of nutrients and decreased bulk density. Since, the compost being a store house of almost all the plant nutrients required for proper growth and development of plants, its addition in soil enhanced availability of these nutrients. Thus, the improvement in soil environment encouraged proliferation of plant roots, which helped to draw more water and nutrients from larger area and deeper layers which in turn increased vegetative growth owing to higher availability of nutrients, more synthesis of carbohydrates and their translocation to different plant parts including the reproductive structures. The incorporation of 2 % canal silt substantially improved the plant height, diameter of umbels, number of umbels $plant^{-1}$, number of seed $umbel^{-1}$, seed yield (g $plant^{-1}$), seed yield (q $ha^{-1}$), dry matter yield (g plant$^{-}$

$^{1}$),dry matter yield (q ha$^{-1}$) of onion seed crop. Thus, the increased availability of moisture and nutrients to the plant under the influence of which applied clay might have helped the plant in greater absorption as observed in the present investigation (Table 4.) and their efficient utilization in vegetative growth and development of reproductive structures and consequently the better height and yield attributes of onion seed crop. These findings corroborate with the findings of Kumawat and Mani Ram (2005). The increase in seed and dry matter yield was probably due to improvement in growth and yield attributes as consequence of increased moisture and nutrient availability under the influence of 2 % canal silt. These results are in close conformity with the findings of Binitha (2006), Yadahalli (2008), Patel *et al.,* (2012) and Sharma *et al.,* (2009).

Significant increase in the growth and yield attributing characters *viz.* plant height, diameter of umbels, number of umbels plant$^{-1}$, number of seed umbel$^{-1}$, seed yield (g plant$^{-1}$), seed yield (q ha$^{-1}$), dry matter yield (g plant$^{-1}$),dry matter yield (q ha$^{-1}$), of onion were observed due to the application of Compost @ 30 t ha$^{-1}$ with 2 % canal silt (Table 4 and 5). The profound influence of soil amendments (compost and canal silt) on the yield attributing characters could be attributed to increased metabolic processes in plants which seem to have promoted meristematic activities causing higher growth and expansion of photosynthetic surface. Thus, it is obvious that the improved growth and development of the crop plants in the present investigation might be the result of enhanced energy transformation and enzyme activation in carbohydrate metabolism and subsequent greater photosynthates partitioning in the yield attribute characters because compost contain nutrient as well as provide better physco-chemical properties of soil for plant growth. The total seed yield of onion is the cumulative effect of yield attributing characters. Significant and positive correlations between total yield and yield attributes also support the higher total seed yield obtained under the present investigation (Table 5). These results are in close conformity with the findings of Binitha (2006), Yadahalli (2008), Patel *et al.,* (2012) and Sharma *et al.,* (2009). Ramprasad *et al.,* (2009) also reported that application of canal silt in the soil helps in retention of nutrients in the soil and increased the fertility of soil which in turn increases crop yield.Among the soil amendments the net returns of onion were recorded higher with Compost @ 30 t ha$^{-1}$ with 2 % canal silt(Table 6). The cost involved under these treatments was comparatively lower than its additional income, which led to more returns under these treatments. It is might due to higher yield produced under above mentioned treatments.Among the fertilizer levels the net returns of onion were recorded higher 125 % RDF(Table 6). The cost involved under these treatments was comparatively lower than its additional income, which led to more returns under these treatments. It is might due to higher yield produced under abovementioned treatments.

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