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Effect of Potash Application on Growth and Yield of Onion Crop with Drip System

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Abstract

Onions (*Allium cepa* L*)* help to protect against cardiovascular diseases, respiratory concerns, diabetes, and a variety of cancers. Pakistan is the 7th largest producer of onion in the world leading by China and followed by India (FAO, 2012). Onion crop removes large quantities of nutrients from the soil, that must be replenished to maintain soil fertility. For 40 tonnes per hectare bulb yield, this amounts to 120 kg N, 50 kg P and 160 kg K per hectare (Tandon and Tiwari, 2008). Keeping in view the situation, a two-year experimental study was conducted at Water Management Research Center (WMRC) to test the effect of Potash on onion growth and yield. The CRD (completely randomizes design) was used under four dozes of Potash with two Replicates. The selected dozes were 50 Kg K_2O per hectare as T_1, 100 Kg K_2O per hectare as T2, 150 Kg K_2O per hectare as T3 and 200 Kg K_2O per hectare as T_4 along with recommended doses of N and P. Growth parameters determined during the experiment were bulb weight, bulb size and plant height. Apart from this nutrient (NPK) uptake was also observed. Results shows that application of 150 Kg K_2O per hectare recorded statistically superior with bulb yield of 53.90 tonnes per hectare but further increment in yield was not detected with higher dozes up to 200 Kg K_2O per hectare. Soil sample analysis at the end of cropping season shows that N and K utilized at their full potential but trace amount of P were left behind in the soil as a loss of fertilizer. It was concluded that 150 Kg K_2O per hectare gives highest yield, further increase in Potash is a loss of fertilizer and it also increases the input cost.

INTRODUCTION

Onion (*Allium cepa* L) is one of the important condiment widely used in all households all the year round. The green leaves and immature and mature bulbs are eaten raw or used in preparation of vegetables. Onions are used in soups, sauces and for seasoning foods. The small bulbs were pickled in vinegar. China was leading in the production of onion with 28.68% followed by India with 18.45%. World production of onion bulb is 86.48 million tonnes. With 2.25% share Pakistan occupied 7th position, USA have 3.90% share, Iran, Egypt, Turkey and Russian Federation have 2.90%, 2.67, 2.49% and 2.47% share in the world production respectively. Dry onion production in the world approached US$ 29491 million during 2011. More the 89.99% onion was consumed within the countries of production. However, the crop export is a major export earner for some countries in the world (FAOSTAT, 2011). Meanwhile, in the onion production both the yield and quality are important considerations. Components of bulb quantity and bulb quality including bulb size, spurting and its decay in storage are very important. Nutriment supply interacts with other management's practices like pest and climatic factors to affect the yield and quality of onion. Nutrient management strategy helps the onion growers to protect the environment from leaching of excess nutriments in the form of excess use of fertilizer to get maximum yield. Excess fertilizer leaches down through the plant root zone while excess phosphorus can be carried out in to the lakes and water bodies through surface runoff. Nutriment management strategies are recommended here to avoid from excess use of nutrients and reduce the losses. Particular varieties have been developed for most of these purposes. Particular varieties for dehydration have a higher onion bulb dry matter 17.5-20.5% than the typical 10-12.5%.

Fresh water is truly the life blood of agriculture that can promise sustainable and consistent food production. Chronically water shortage is a real threat to sustainable production of food and fibre crops in many arid and semi-arid regions where crop production depends on supplementary irrigation. According to global climate change impact, the irrigation water availability may decrease in the future globally (World Water Assessment Program, 2009) which may influence its availability and cost in future. According to water security index 2010 given by Maplecroft for global risk analysis, Pakistan is ranked at 7th position in list of countries having extreme risk of water shortage (WSRI, 2010).

Today Pakistan is sixth most populous country of the world. The increase in population demands more food and fibre and put enormous pressure on water resources of Pakistan. IWMI (2000) reported that owing to increase in population; Pakistan will be directed to utmost water insufficient by 2025. WAPDA (2011) reported that water accessibility per person in 1951was 5,260 m^3 that turned down to 1038 m^3 in 2010 and continuous to decline. The reduction in water availability has direct influence on crop production and hence can adversely affect the water productivity.

From former age, agriculture has been the prime profession of the populace of Pakistan. According to Economic Survey of Pakistan 2013-14, agriculture contribution in Pakistan's economy is 21.0 percent of GDP and engages almost 43.7 percent of the total employed labour force of the country, however agriculture utilizes around 90-95% of the freshwater (Sayed, 2011). It not only feeds the fatten population but also provides raw material for industries and a base for foreign exchange. In Pakistan, majority of farmers are still stuck to traditional methods of crop cultivation and use more fertilizer and irrigation water, often together to get higher yield. Besides high production cost, over use of agrochemicals and water can reduce yield and results in plant disease, nutrient leaching, and reduced pesticide effectiveness which is also wastage of water and energy. In Pakistan, farmers usually apply irrigation water to unlevelled fields, resulting poor water uniformity and low irrigation efficiency. Studies in Pakistan show that amount of water applied per irrigation is 13–18 cm, which is significantly higher than the crop water requirement between two irrigation events, i.e. around about 8 cm (Kahlown *et al.*, 2001) and on-farm irrigation efficiencies vary from 23 to 70% (Clyma and Ashraf, 1975; Kalwij, 1997; Kijne and Kuper, 1995; Kahlown *et al.*, 1998).

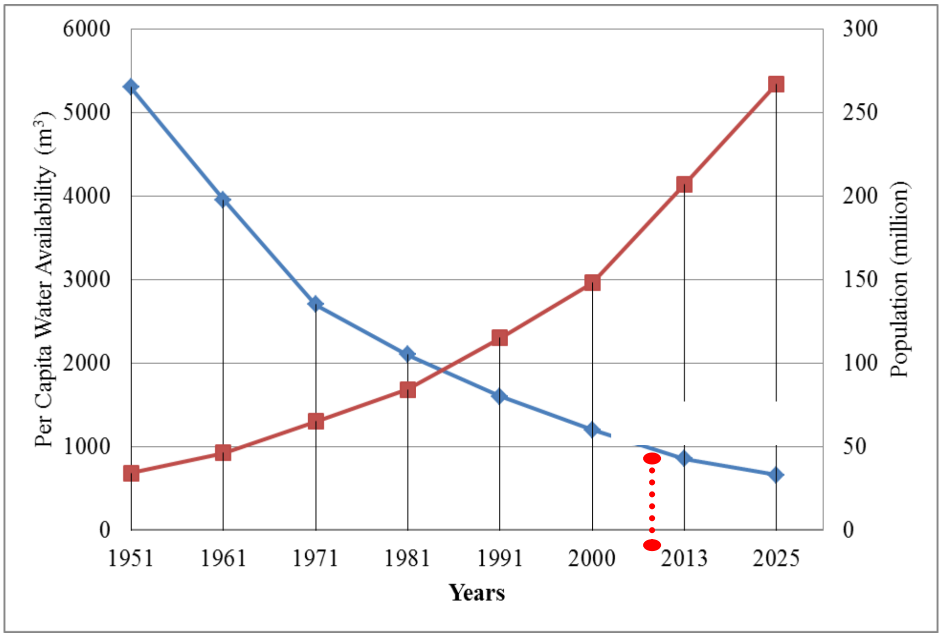

Figure 1: Per capita water availability variation in Pakistan (IWMI, 2000).

With water availability on the decline and high rates of population growth, there is dire need to optimize irrigation management in order to increase the yield per drop of water to combat water shortage. The most important factor affecting irrigation efficiencies and crop yields is the timing and amount of water applied. Decisions on when and how much to irrigate are critical when water supply is limited and prices are high. In Pakistan, most commonly used scheduling methods by farmers includes scheduling according to the calendar (number of days since the last irrigation), looking crop color or feeling soil moisture with hand. These methods do not consider soil type and weather parameters, which may cause problems.

Various irrigation scheduling approaches are available to help producers to apply the correct amount of water at the correct time. Climatological approach integrates all the weather parameters (Solar radiation, temperature, wind speed, relative humidity, etc) for determining crop water demand. However, evaporation from pan does not resemble the biological or physical use of water by crops but it is driven by similar atmospheric variables and correlates relatively well with crop water use or potential ET (Penman, 1948).

MATERIALS AND METHODS

Site Description

Experiment was conducted at the Water Management Research Centre (WMRC), Jhang road, Faisalabad on onion crop during 2013-14. The longitude and latitude of the experimental area was 31.4377 ºN and 73.07 ºE respectively, at the elevation of 190.76 m from sea level. The site area is famous for mixes cropping patterns including cotton, sugarcane, wheat, corn and almost all vegetables. The source of irrigation water on the site is canal supply, groundwater of marginal quality from a skimming tube well which consists of five shallow bores up to 30 m depth, and poor-quality water from a single bore deep well of 50 m depth.

Soil

The study area is a part of the Indus plain, which consists of alluvial deposits from the Himalayas. Soil samples were taken and tested in WMRC laboratory to check the soil characteristics. After crop harvesting again soil sample were taken to check the leaching, deposition of nutrients and salts in the soil. The soils in the area were of medium textured and texturally and structurally homogeneous up to depth of 4 m. These soils were underlain by thick loamy sand to medium sandy loam highly conductive aquifer. The soils of the study area were predominantly medium to moderately coarse with favourable permeability characteristics and there exists a similar pattern throughout the area. Such soils were generally low in organic matter and are adoptable to a wide variety of crops. The topography of the study area was relatively flat. The study area was situated at an elevation of 183 m above mean sea level.

Experimental Design

Experimental study was designed to test the effect of Potash on onion growth and yield. The CRD (completely randomizes design) was used under four dozes of Potash fertilizer treatments with two Replicates. The experiment was repeated for two years in 2013-14 in the same growing season. The selected dozes were 50 Kg k_2O ha^{-1} as T_1, 100 Kg K_2O ha^{-1} as T2, 150 Kg K_2O ha^{-1} as T3 and 200 Kg K_2O ha^{-1} as T4 along with recommended doses of N and P. Onion crop was planted on bed sowing with four rows and drip line for irrigation purpose was installed in the centre of bed. Bed wreath was 75 cm. Middle rows of onion were 20 cm apart from each other and outer onion line are 12.5 cm apart next to middle line and 7.5 cm distance at the edge of bed. For irrigation 10cm wide and 7.5 cm deep furrow was made in the centre of bed. Drip pipe with emitter distance of 30cm was used. Granular fertilizer dissolved in water at each treatment and applied in the field through drip system to use full potential of fertilizer with minimum losses.

Land Preparation and Sowing

The seeds were sown on 15^{th} October every year (2013-14) for nursery rising. Nursery raised for the duration of four weeks. By using bed planter beds were made and nursery was transplanted in the field at 5cm soil depth. Meanwhile the field was ploughed with cultivator and levelled.

Data Collection

After 4 weeks of nursery maturity, beds were made by using bed planter in a field. Water was applied after transplanting the nursery in the field. Germination percentage, crop height, water applied and fertilizer applied was recorded daily. At the time of harvest, bulb yield per meter square, number of bulbs and bulb diameter was also recorded.

Drip Irrigation System

Drip irrigation also known as low flow, micro, and trickle irrigation and involves dripping water onto the soil at very low rates (2-20 litres/hour) from a system of small diameter plastic pipes fitted with outlets called emitters or drippers. Water was applied close to plant so that only part of the soil in which the roots grow is wetted, unlike surface and sprinkler irrigation, which involves wetting of the whole soil profile. With drip irrigation water application were more frequent (usually every 1-3 days) than with other methods and this provides a very favourable high moisture level in the soil in which plant can flourish.

Calculations

First application rate of drip system was calculated by using the following equation:

$$Applicationrate\left(\frac{mm}{hr}\right) = \frac{emitterdischarge(Lph)}{lateralspacing(m) \times emitterspacing(m) \times efficiency} (1)$$

Where, lateral spacing is 0.91 m, emitter spacing is 0.45 m and efficiency of the system is 70%.

Operation time for drip system was calculated by using following formula:

$$OperationTime(hr) = \frac{Applieddepth(mm)}{Applicationrate\left(\frac{mm}{hr}\right)} (2)$$

Crop water requirement was calculated by using the formula:

$$ETc = Eto * Kc(3)$$

Fertilizer was applied through drip system at different stages of maturity and data recoded.

RESULTS AND DISCUSSON

Results show that application of 150 Kg K_2O per hectare recorded statistically superior with bulb yield of 53.90 tonnes per hectare and 54.5 tonnes per hectare in 2013 and 2014 respectively but no remarkable increment in the yield with higher dozes up to 200 Kg K_2O per hectare in both years. Onion bulb size in the year 2013-14 was 8.56 cm and 8.8 cm which was higher in T3 treatment with 150 Kg K_2O per hectare. Increase in fertilizer dozes resulted in no further increase in the bulb size of onion. Fertilizer dozes were same in both the years 50, 100, 150 and 200 Kg K_2O per hectare respectively in four treatments. T3 was leading in the plant height with 55 and 56.25 cm respectively in 2013 and 2014, followed by T4 with 54.5 and 54.95cm respectively.

Soil sample analysis at the end of cropping season were shown that N and K were utilized at their full potential because they are readily available to the plants. Soil sample analysis results shows that N and K were not left behind in the soil but trace amount (0.5%) of P was left behind in the soil as a loss of fertilizer. It was concluded that 150 Kg K_2O per hectare gave highest yield, further increase in Potash is a loss of fertilizer and it increase the input cost also.

Results showed that the bulb yield was higher in treatment T3 as 533 Mounds/acre with 150 kg K_2O ha^{-1} of fertilizer and in T4 treatment results revealed that no significat increament in the bulb yield with increase of K_2O fertilizer.

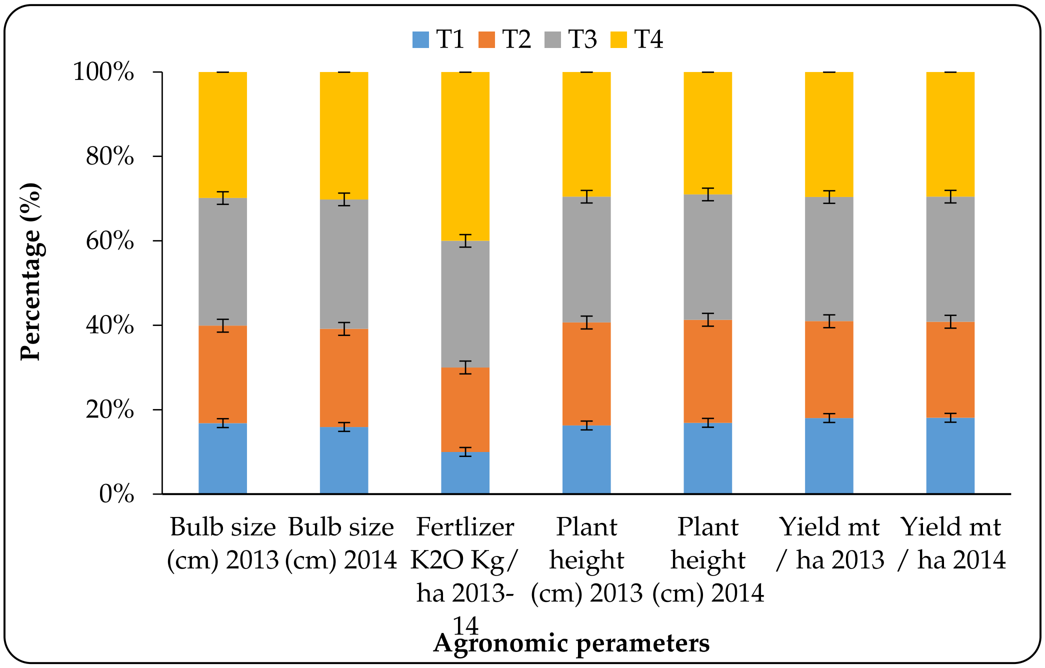

Figure 2: Comparison of bulb size, fertilizer rate, plant height and yield 2013-14.

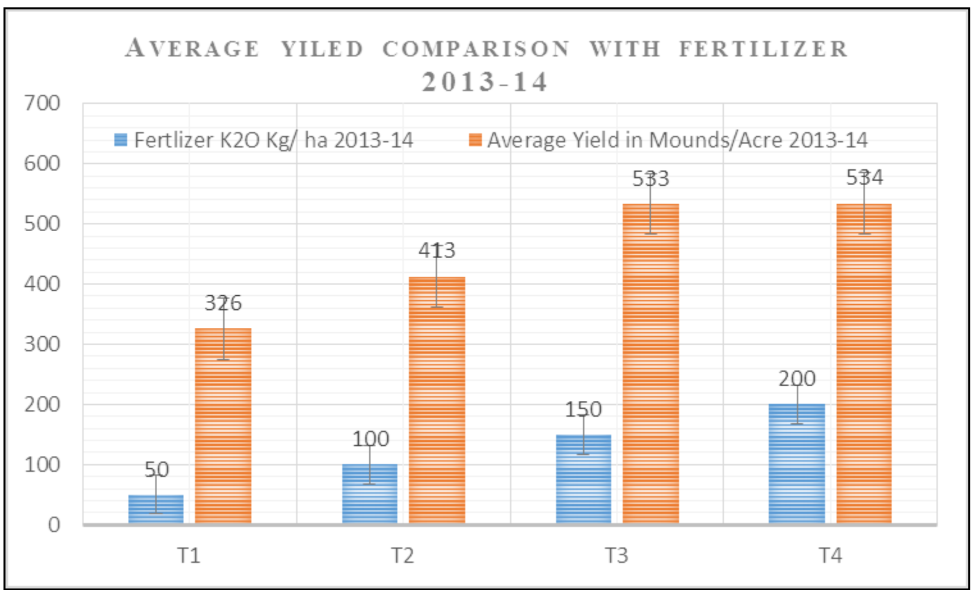

Figure 3: Comparison of average yield with fertilizer dozes.

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