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Effect of Residual Nutrients of Potato Crop on Growth, Yield Attributing Characters and Yields of Spring Maize (*Zea mays* L.)

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ABSTRACT: The present investigation was conducted on maize crop in spring season of 2020-21 at the Crop Research Centre, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut-250110. The soil of experimental field was sandy loam in texture and slightly alkaline in reaction. The soil was low in available nitrogen and sulphur, medium in phosphorus and potassium. The experiment consisting 13 treatments in previous potato crop *viz.*, T1 (RDF NPK and S (Common fertilizers), T2 (RDF N and P (no-K, no-S) (Common fertilizers), T3 (RDF NP and S (no-K) (Common fertilizers), T4 (RDF NP and K (no-S) (Common fertilizers), T5 (RDF NP and 50% of RDF K by POLY-4), T6 (RDF NP +100% POLY-4), T7 (RDF NP and 150% of RDF K by POLY-4), T8 (RDF NP+ 50% of RDF K by MOP + 50% of RDF S equal to T5 by Bentonite), T9 (RDF NP+ 100% of RDF K by MOP+100% of RDF S equal to T6 by Bentonite), T10 (RDF NP+ 150% of RDF K by MOP + 150% of RDF S equal to T7 by Bentonite), T11 (RDF NP and 25% K by MOP + 75% by POLY-4), T12 (RDF NP and 50% K by MOP + 50% by POLY-4), T13 (RDF NP and 75% K by MOP + 25% by POLY-4) was laid out in randomized block design with three replication. Only 75% of recommended dose of N & P was applied in maize crop to observe the residual effect of previously applied nutrients. The findings of experiment revealed that the growth attributes like plant height, functional leaves per plant, chlorophyll content (SPAD Value) and yield attributes *i.e.* grain yield was maximum with application of RDF NP and 150% of RDF K by POLY-4 (T7) followed by RDF NP and 25% K by MOP + 75% by POLY-4 (T11) applied in previous crop. Polyhalite was superior over common fertilizer MOP. Residual effect varied due to source of potassium application and polyhalite was found better than MOP. Super optional application of K to preceding crop resulted in more residual effect therefore it may be concluded that nutrient management should be consider on cropping sequence basis rather than single crop and polyhalite may be a good source for potassium.

Keywords: Polyhalite, Residual effect, SPAD, Bentonite and Chlorophyll content.

INTRODUCTION

Maize (*Zea mays* L.) is a member of the Poaceae family and is native to Central America and Mexico. Because it has the highest genetic yield potential among cereals, it is known as the "Queen of Cereals". Maize is cultivated all year in many parts of India. Maize is a very essential fodder crop, especially for milch animals. It is a C_4 plant having high fodder production capacity in short duration. It is most versatile emerging crop having wider adaptability under various agro-climatic conditions. It is cultivated on nearly 190 m ha in about 165 countries having wider diversity of soil, climate, biodiversity and management practices that contributes 39 % in the global grain production. The United States of America (USA) is the largest Producer of maize contributes nearly 36% of the total production in the world and maize is the driver of the US economy. In India, Maize is grown throughout the year. According to advance estimate the area of maize 9.57 Mha, production 28.77 Mt. & average productivity 3006 kg ha^{-1}. In India the status of UP under maize is very poor (0.73 Mha) area, (1.53 Mt) production, (2095 kg ha^{-1})

productivity. (Directorate of Economics & Statistics 2019-20). After rice-wheat and rice-rice, maize-wheat is the third most significant cropping system, accounting for roughly 3% of the national food basket. Potato-spring maize, potato-maize-urd, potato-maize-sunflower, maize-potato-onion, maize-potato-sugarcane-ratoon, maize-potato-green gram are important maize based systems in India. Among all the cereals, maize hybrids are responsive to nutrients application either through organic or inorganic sources. The rate at which nutrients are applied is largely determined by the soil's nutrient condition, balance, and cropping system. Because maize has a noticeable response to organic manures, integrated nutrient management (INM) is a useful nutrient management technique in maize-based cropping systems. However, due to the high cost of fertilizers, this is not feasible in the majority of countries. As a consequence, farmers reduce the high cost of chemical fertilizers by using both accessible organic sources and a reasonable quantity of chemical fertilizers to increase crop yields. The organic matter or crop residue helps to recycle the nutrients to correct their deficiencies. Studies indicated that use of organic sources can help maintain a better N: P ratio and higher yield (Bakhtiar *et al.,* 2002, Khanam *et al.,* 2001). Incorporation of organic sources at much higher rates had been found useful but may not be affordable by small or low-income farmers (Ahmad, 2000). Farmers can use crop residue from previously produced crops as an alternative to solve the problem of poor soil fertility. Crop residue recycling improves the overall attributes of soil by enhancing its fertility and consequently results in better establishment of the crop. Polyhalite, a new mineral fertilizer (POLY-4), mined in the UK from deep underground. Poly-4 is the trademark name for polybasite products from Anglo American's Crop Nutrients business. POLY-4 is a multi-nutrient and low-chloride fertilizer suitable for organic farming. POLY-4 is a highly efficient and effective fertilizer that enables farmers to enhance crop production, improve soil quality, and improve soil structure all with one product. Poly-4 has a nutritional value of 14% K_2O, 17% CaO, 6% MgO and 19% S, as well as a solubility of 27 g L^{-1} in water at 25°C and pH neutrality. Bentonite is an off-white montmorillonite clay generated from altered volcanic ash and is one of the most major sources of sulphur, containing 90% S. Keeping all foregoing facts in view, an experiment is entitled effect of residual nutrients of potato crop on growth, yield attributing characters and yields of spring Maize (*Zea mays* L.) has been carried out after harvesting of potato crop.

MATERIALS AND METHODS

The field experiment was conducted during 2020-21 at Crop Research Centre, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.), located at a latitude of 290 4' North and longitude of 770 42' East with an elevation of 228 meter above the mean sea level. The experimental site had an even topography with good drainage facilities system in farm. Meerut comes in semi-arid and sub-tropical climatic zone. Moderate rainfall and wide temperature variation are the characteristic features of the semi-arid and sub-tropical climate. The mean minimum temperature reaches as low as 3 °C in winters, while during summer the mean maximum temperature varies from 36-38 °C in June. The mean weekly lowest and highest temperatures recorded during the crop growth period were 24.9 °C and 38.5 °C, respectively. Data showed that average maximum weekly temperature ranged between 38.5 °C in May to 38.1 °C in June, while average minimum weekly temperature ranged between 11.3 °C to 27 °C. The mean weekly minimum and maximum relative humidity varied between 22.0 to 59.9 % and 46.6 to 94.8 %, respectively. The total amount of rainfall received during crop period was 136.4 mm. The minimum and maximum mean weekly sunshine hours during crop growth period was 6.3 and 11.0 hrs.' respectively. The soil of the experimental field was sandy loam in texture and slightly alkaline in reaction. The soil was medium in available phosphorus and available potassium but low in organic carbon, sulphur and available nitrogen. Seeds are sown in 7-8 cm deep furrow opened with the help of plant junior on the lines marked maintaining 60 cm row to row spacing. The variety pioneer 1844 seeds were placed manually in the furrows, using a higher seed rate (25 kg ha^{-1}) as to maintain uniform plant population of 5 plants m^{-1} row length with a plant to plant distance of 20 cm. The experiment was conducted in layout of previous experiment. There were 13 treatments replicated thrice in Randomized Block Design. Only nitrogen and phosphorus of 75% of recommended dose were applied in each plots through urea and DAP. Nitrogen was applied in two split doses (50% basal + 25% at knee high stage; 30-35 days after sowing) and phosphorus as basal application.

RESULT AND DISCUSSION

A. Growth

Plant height. The plant height measured under the influence of residual nutrients are presented in Table 1 and depicted in Fig. 1. The plant height increased as the growth progressed significantly with the application of different treatments applied in previous crop and their residual effect on maize crop. The maximum plant height was recorded 251.5 cm followed by 249.0 cm found in the plot where RDF NP and 150% of RDF K by POLY-4 (T7) and RDF NP and 25% K by MOP + 75% by POLY-4 (T11) were applied in potato, that shows application & their residual effect of 150% of RDF K by POLY-4 (T7) was more beneficial than the remaining treatment. The minimum plant height was recorded 227.8 cm in RDF NP and S (no-K) (T3) where no potassium was applied. Where Super optional application of K through POLY-4 in previous crop resulted in high plant height which was significantly higher than the treatments with exception of T4, T5, T6, T9, T10, T11, and T12. Plant height in T7 was 2.1 percent higher than T10 where 150% K to potato was supplied by MOP. This clearly indicates the better residual effect of POLY-4. This finding was supported by Nawale *et al.* (2009), Svubure *et al.* (2010) and Kundu *et al.* (2012).

Number of functional leaves. Summarized data on number of functional leaves as an index of growth and development recorded under the influence of residual nutrients are presented in Table 1 and depicted in Fig. 1. The maximum number of functional leaves/plant (10.4) was observed in plot where RDF NP and 150% of RDF K by POLY-4 (T7) were applied in previous crop. The minimum number of functional leaves per plant recoded 9.5 with application of RDF N and P (no-K, no-S) (T2). The differences were statistically non-significant. A similar finding has been reported by Kumari *et al.* (2016).

Table: 1. Effect of residual nutrients of potato crop on growth of maize.

Treatments	Plant height (cm)	Number of functional leaves	Dry matter accumulation (g plant^{-1})	SPAD Value
RDF NPK and S (Common fertilizers)	239.7	10.1	146.9	49.7
RDF N and P (no-K, no-S) (Common fertilizers)	227.8	9.5	141.7	47.3
RDF NP and S (no-K) (Common fertilizers)	227.8	10.0	140.9	48.9
RDF NP and K (no-S) (Common fertilizers)	244.7	9.9	143.3	46.0
RDF NP and 50% of RDF K by POLY-4	249.0	10.0	157.7	51.3
RDF NP and 100% of RDF K by POLY-4	249.0	10.3	163.1	51.5
RDF NP and 150% of RDF K by POLY-4	251.5	10.4	172.3	51.7
RDF NP+ 50% of RDF K by MOP+50% of RDF S equal to T5 by Bentonite	246.1	10.1	151.3	51.2
RDF NP+ 100% of RDF K by MOP+100% of RDF S equal to T6 by Bentonite	242.0	10.0	148.9	51.4
RDF NP+ 150% of RDF K by MOP+150% of RDF S equal to T7 by Bentonite	246.3	10.2	152.9	49.6
RDF NP and 25% K by MOP + 75% by POLY-4	249.0	9.9	170.4	51.3
RDF NP and 50% K by MOP + 50% by POLY-4	243.8	9.9	166.8	49.0
RDF NP and 75% K by MOP + 25% by POLY-4	238.9	9.8	159.4	48.5
SEm±	***3.6***	***0.3***	***5.6***	***1.3***
CD (at 5%)	***3.6***	***NS***	***16.6***	***NS***

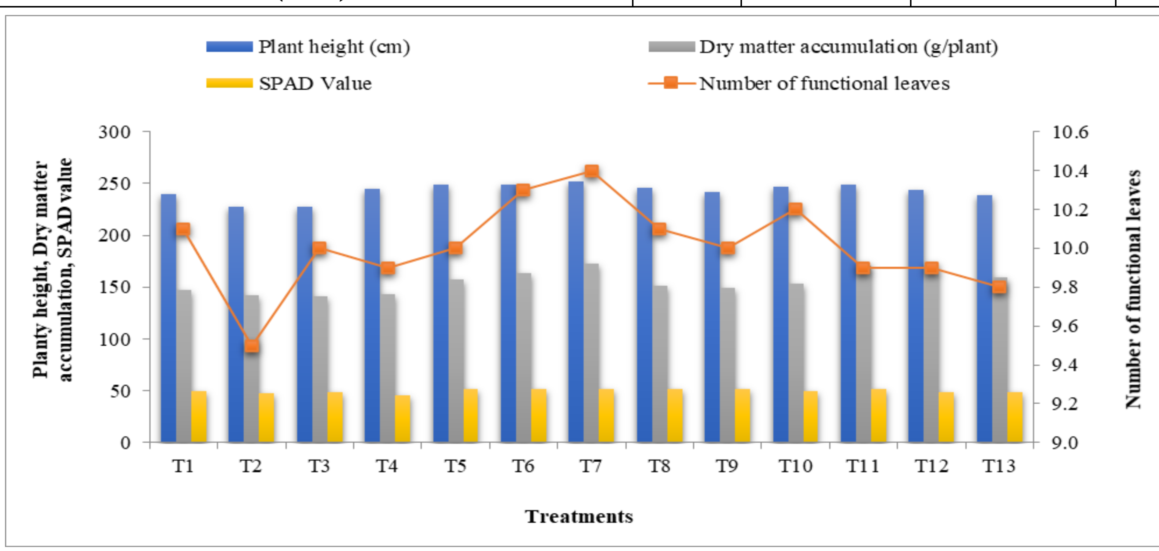

Fig. 1. Effect of residual nutrients of potato crop on growth of maize.

Dry matter accumulation (g plant^{-1}). The data pertaining to dry matter accumulation (g plant^{-1}) are influence with the application of different treatments applied in previous crop and their residual effect on maize crop are presented in Table 1 and depicted in Fig. 1. The dry matter accumulation (g plant^{-1}) ranged from 140.9 (g plant^{-1}) to 172.3 (g plant^{-1}). The maximum dry matter accumulation was recorded 172.3 (g plant^{-1}) followed by 170.4 (g plant^{-1}) found in the plot where RDF NP and 150% of RDF K by POLY-4 (T7) and RDF NP and 25% K by MOP + 75% by POLY-4 (T11) respectively was applied in previous crop. That shows application of 150% of RDF K by POLY-4 (T7) was more beneficial than the remaining treatment. Omission of potassium in previous crop (T3) had apparent negative impact on dry matter accumulation of maize and recorded least (140.9 g plant^{-1}) where application of K through POLY-4 in previous crop resulted in higher dry matter accumulation which was significantly higher than the treatments with exception of T5, T6, T11, T12 and T13. Dry matter accumulation in T7 was 12.6 percent higher than T10 where 150% K to potato was supplied by MOP. This clearly indicates the much better residual effect of POLY-4. This finding was supported by Sujatha *et al.* (2010) and Lal and Singh (2007).

SPAD (Soil Plant Analysis Development) Value: The Soil Plant Analysis Development (SPAD) Chlorophyll meter is one of the most commonly used diagnostic tool to measure the crop nitrogen status or crop vigorous. The meter estimates the amount of chlorophyll present, by measuring the amount of light that is transmitted through a leaf. The relevant data on chlorophyll (SPAD Value) content as it affected by different treatments applied in previous crop and their residual effect on maize crop are presented in Table 1 and depicted in Fig. 1. At 90 DAS the chlorophyll content (SPAD Value) ranged 47.3 to 51.7. The maximum value of SPAD 51.7 in plot where RDF NP and 150% of RDF K by POLY-4 (T7) was applied in previous crop. While minimum value of SPAD 47.3 in RDF NP and S (no-K) (T2) was observed. The chlorophyll content (SPAD Value) was statistically non-significant under the influence of different treatment.

B. Yield attributing characters

Cob length (cm). The data pertaining on cob length are presented in Table 2 and Fig. 2. The cob length of maize was statistically did not differ significantly under the influence of different treatments applied in previous crop and their residual effect on maize. The maximum cob length was (19.1 cm) observed in plot where RDF NP and 25% K by MOP + 75% by POLY-4 (T11) and minimum (17.2 cm) in RDF NPK and S (T1) and RDF NP and S (no-K) (T3) treatment was applied in previous crop. These findings were supported by Nawle *et al*. (2009) and Awopegba *et al.* (2016).

Number of grains row^{-1}. The data pertaining on number of grains row^{-1} are presented in Table 2 and Fig. 2. Number of grains cob^{-1} row^{-1} was statistically did not differ significantly under the influence of different treatments applied in previous crop. Highest number of grains row^{-1} 38.7 followed by 38.5 was found in plot where RDF NP and 150% of RDF K by POLY-4 (T7) and RDF NP and 50% of RDF K by POLY- 4 (T5) was applied in previous crop. The highest number of grains cob^{-1} row^{-1} 38.7 found in plot where RDF NP and 150% of RDF K by POLY-4 (T7) and minimum number of grains cob^{-1} row^{-1} 34.6 found in RDF NP and 75% K by MOP + 25% by POLY-4 (T13) was applied in previous crop.

Number of grains cob^{-1}. The data pertaining on number of grains cob^{-1} are presented in Table 2 and Fig. 2. Number of grains cob^{-1} under the influence of different treatments applied in previous crop and their residual effect on maize. Highest number of grains cob^{-1} 713.2 followed by 709.8 found in RDF NP and 150% of RDF K by POLY-4 (T7) and RDF N and P (no-K, no-S (T2) respectively was applied in previous crop. The highest number of grains cob^{-1} 713.2 found in plot where RDF NP and 150% of RDF K by POLY-4 (T7) and minimum number of grains cob^{-1} 595.1 found in RDF NP and 75% K by MOP + 25% by POLY-4 (T13) was applied in previous crop. Where Super optional application of K through POLY-4 in previous crop resulted in higher number of grains cob^{-1} which was significantly higher than the treatments with exception of T1, T2, T3, T5, T6, T10, T11 and T12. Number of grains cob^{-1} in T7 was 2.06 percent higher than T10 where 150% K to potato was supplied by MOP. This clearly indicates the much better residual effect of POLY-4.

Grains weight per cob (g). The data pertaining on grains weight per cob (g) are presented in Table 2 and Fig. 2. The grains weight per cob (g) under the influence of different treatments applied in previous crop and their residual effect on maize. Grains weight per cob (g) increased as the growth progressed significantly with the application of different treatments and their residual effect. The maximum grains weight per cob was recorded 146.7 (g) followed by 145.0 (g) found in RDF NP and 25% K by MOP + 75% by POLY-4 (T11) and RDF NP and 50% RDF K by POLY-4 (T6) respectively, that shows application of 25% K by MOP + 75% by POLY-4 (T11) was more beneficial than the remaining treatment. The minimum grains weight per cob was recorded 95.0 g RDF N and P (no-K, no-S) (T2). Grain weight in T11 was 12.6 percent higher than T10 where 150% K to potato was supplied by MOP. This clearly indicates the much better residual effect of POLY-4. A similar finding has been reported by Kumar and Thakur (2009).

Table 2: Effect of residual nutrients of potato crop on yield attributing characters of maize.

Treatments	Cob length (cm)	Number of grains row^{-1}	Number of grains cob^{-1}	Grain weight cob^{-1}	Cob weight (g)	Test weight (g)
RDF NPK and S (Common fertilizers)	17.2	36.7	637.8	110.2	202.4	234.8
RDF N and P (no-K, no-S) (Common fertilizers)	17.9	38.3	709.8	95.0	188.2	215.0
RDF NP and S (no-K) (Common fertilizers)	17.2	37.0	646.8	98.2	195.5	219.2
RDF NP and K (no-S) (Common fertilizers)	17.9	35.7	599.8	104.3	208.2	226.4
RDF NP and 50% of RDF K by POLY-4	19.5	38.5	676.9	134.2	219.1	238.1
RDF NP and 100% of RDF K by POLY-4	17.8	37.1	663.2	145.0	220.4	242.8
RDF NP and 150% of RDF K by POLY-4	18.4	38.7	713.2	139.2	232.0	246.5
RDF NP+ 50% of RDF K by MOP+50% of RDF S equal to T5 by Bentonite	17.8	36.2	629.6	133.2	218.2	238.4
RDF NP+ 100% of RDF K by MOP+100% of RDF S equal to T6 by Bentonite	18.0	36.6	626.6	129.4	220.7	239.2
RDF NP+ 150% of RDF K by MOP+150% of RDF S equal to T7 by Bentonite	19.0	37.6	698.8	130.2	212.8	235.1
RDF NP and 25% K by MOP + 75% by POLY-4	19.1	38.2	688.6	146.7	229.2	247.2
RDF NP and 50% K by MOP + 50% by POLY-4	17.7	36.4	642.0	139.4	220.9	245.3
RDF NP and 75% K by MOP + 25% by POLY-4	17.3	34.6	595.1	140.0	215.6	241.7
SEm±	***0.7***	***1.7***	***26.6***	***4.6***	***7.8***	***5.96***
CD (at 5%)	***NS***	***NS***	***77.7***	***13.7***	***22.9***	***17.4***

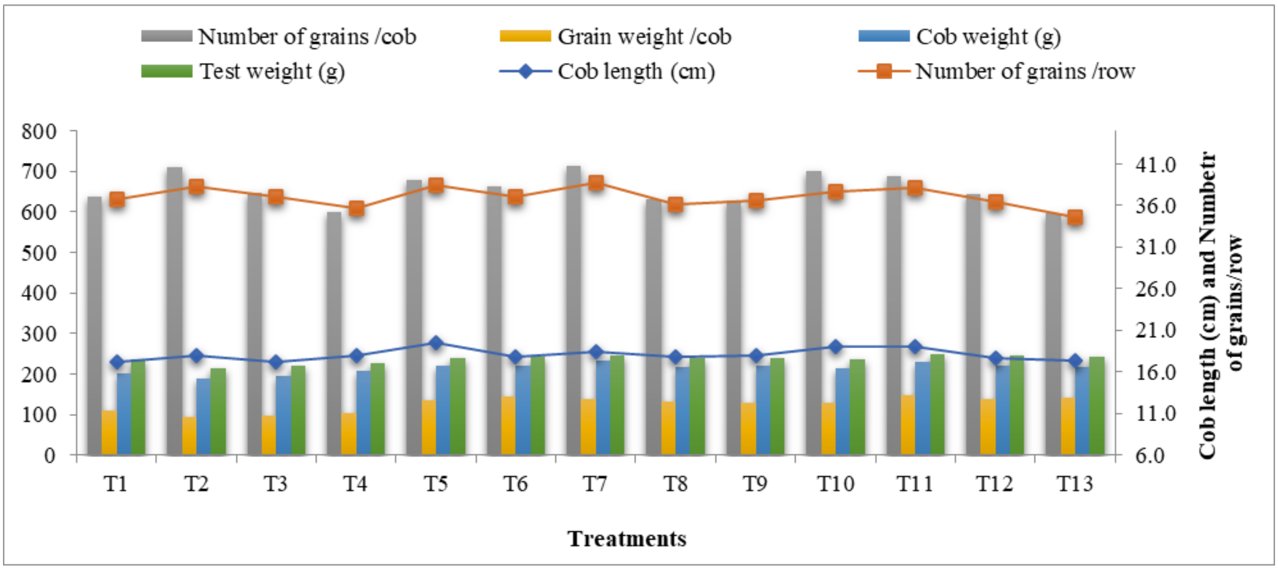

Fig. 2. Effect of residual nutrients of potato crop on yield attributing characters of maize.

Cob weights (g). The data pertaining on cob weights (g) are presented in Table 2 and Fig. 2. The cob weights (g) under the influence of different treatments applied in previous crop and their residual effect on maize. The maximum cob weight (g) was recorded 232.0 (g) followed by 229.2 (g) found in RDF NP and 150% of RDF K by POLY-4 (T7) and RDF NP and 25% K by MOP + 75% by POLY-4 (T11) respectively, was applied in previous crop. That shows application of 150% of RDF K by POLY-4 (T7) was more beneficial than the remaining treatment while minimum cob weight (g) was recorded 188.2 g RDF N and P (no-K, no-S) (T2). Where Super optional application of K through POLY-4 in previous crop resulted in higher cob weight which was significantly higher than the treatments with exception of T5, T6, T8, T9, T10, T11, T12 and T13. Cob weight in T7 was 9.0 percent higher than T10 where 150% K to potato was supplied by MOP and additional. This clearly indicates the much better residual effect of POLY-4.

Test weight (g). The data pertaining on test weight (g) are presented in Table 2 and Fig. 2. The test weight (g) was statistically significant under the influence of different treatments applied in previous crop and their residual effect on maize. The highest test weight 247.2 (g) found in plot where RDF NP and 25% K by MOP + 75% by POLY-4 (T11) followed by 246.5 (g) found in RDF NP and 25% K by MOP + 75% by POLY-4 (T11) and RDF NP and 150% of RDF K by POLY-4 (T7) respectively. The highest test weight 247.2 found in plot where RDF NP and 25% K by MOP + 75% by POLY-4 (T11) The minimum test weight 215.0 found in RDF N and P (no-K, no-S) (T2). Where Super optional application of K through POLY-4 in previous crop resulted in higher test weight which was significantly higher than the treatments with exception of T1, T5, T6, T7, T10, T12 and T13. Test weight in T11 was 5.14 percent higher than T10 where 150% K to potato was supplied by MOP and additional. This clearly indicates the much better residual effect of POLY-4. These findings were supported by Nawle *et al*. (2009), Das *et al.* (2016) and Awopegba *et al.* (2016).

C. Yields

Biological yield (t ha^{-1}). Data regarding different treatments applied in previous crop and their residual effect on maize grain yield, stover yield, biological yield and harvest index are given Table 3 and depicted in Fig. 3. It is clear from the data the biological, grains and stover yield were significantly affected by residual effect of different treatments. Biological yields ranged from 8.5 (t ha^{-1}) to (13.1 t ha^{-1}) under different treatments. Maximum biological yield (13.1 t ha^{-1}) followed by (12.9 t ha^{-1}) found in RDF NP and 150% of RDF K by POLY-4 (T7) and RDF NP and 25% K by MOP + 75% by POLY-4 (T11) respectively. The maximum biological yield (13.1 t ha^{-1}) was recorded in plot where RDF NP and 150% of RDF K by POLY-4 (T7) applied in previous crop. The minimum biological yield recorded (8.5 t ha^{-1}) recorded with RDF NP and S (no-K) (T3). Where Super optional application of K through POLY-4 in potato crop resulted in higher biological yield which was significantly higher than the treatments with exception of T5, T6, T11, T12 and T13. Biological yield in T7 was 23.5 percent higher than T10 where 150% K to potato was supplied by MOP. This clearly indicates the much better residual effect of POLY-4.

Stover yield (t ha^{-1}). The stover yield ranged from (4.8 t ha^{-1}) to (7.2 t ha^{-1}) under different treatments. Maximum stover yield (7.2 t ha^{-1}) followed by (7.1 t ha^{-1}) found in RDF NP and 150% of RDF K by POLY-4 (T7) and RDF NP and 100% of RDF K by POLY-4 (T6) respectively. The maximum stover yield (7.2 t ha^{-1}) was recorded in plot where RDF NP and 150% of RDF K by POLY-4 (T7) applied in previous crop. The minimum stover yield (4.8 t ha^{-1}) was recorded in plot where RDF NP and S (no-K) (T3) and (T2) respectively applied in previous crop where super optional application of K through POLY-4 in potato crop resulted in higher stover yield which was significantly higher than the treatments with exception of T5, T6, T11, T12 and T13. Stover yield in T7 was 30.9 percent higher than T10 where 150% K to potato was supplied by MOP. This clearly indicates the much better residual effect of POLY-4. This finding was supported by Mahala *et al.* (2006).

Table 3: Effect of residual nutrients of potato crop on yield of maize.

Treatments	Grain yield (t ha^{-1})	Stover yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
RDF NPK and S (Common fertilizers)	4.6	5.1	9.7	47.5
RDF N and P (no-K, no-S) (Common fertilizers)	3.8	4.8	8.6	44.2
RDF NP and S (no-K) (Common fertilizers)	3.8	4.8	8.5	43.6
RDF NP and K (no-S) (Common fertilizers)	4.1	4.9	9.0	45.6
RDF NP and 50% of RDF K by POLY-4	5.2	6.8	12.0	43.3
RDF NP and 100% of RDF K by POLY-4	5.4	7.1	12.5	43.2
RDF NP and 150% of RDF K by POLY-4	5.9	7.2	13.1	45.0
RDF NP+ 50% of RDF K by MOP+50% of RDF S equal to T5 by Bentonite	4.5	5.4	10.0	45.0
RDF NP+ 100% of RDF K by MOP+100% of RDF S equal to T6 by Bentonite	4.9	5.5	10.4	47.1
RDF NP+ 150% of RDF K by MOP+150% of RDF S equal to T7 by Bentonite	5.1	5.5	10.6	48.1
RDF NP and 25% K by MOP + 75% by POLY-4	5.8	7.0	12.9	45.0
RDF NP and 50% K by MOP + 50% by POLY-4	5.6	7.0	12.6	44.5
RDF NP and 75% K by MOP + 25% by POLY-4	5.3	6.7	12.0	44.1
SEm±	***0.19***	***0.22***	***0.40***	***1.65***
CD (at 5%)	***0.58***	***0.64***	***1.17***	***NS***

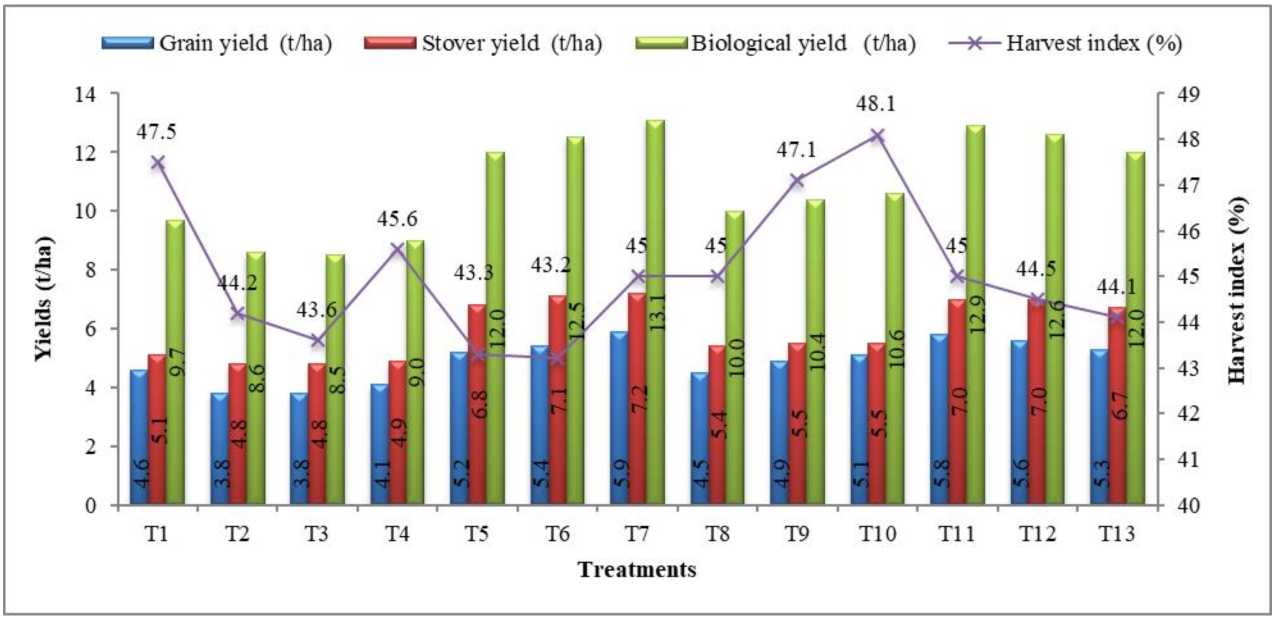

Fig. 3. Effect of residual nutrients of potato crop on yield of maize

Grain yield (t ha^{-1}). The grain yield ranged from (3.7 t ha^{-1}) to (5.9 t ha^{-1}) under different treatments. Maximum grain yield (5.9 t ha^{-1}) followed by (5.8 t ha^{-1}) found in RDF NP and 150% of RDF K by POLY-4 (T7) and RDF NP and 25% K by MOP + 75% by POLY-4 (T11) respectively. The maximum grain yield (5.9 t ha^{-1}) was observed in plot where RDF NP and 150% of RDF K by POLY-4 (T7) applied in previous crop. The minimum grain yield (3.7 t ha^{-1}) was recorded in plot where RDF NP and S (no-K) (T3) where super optional application of K through POLY-4 in potato crop resulted in higher grain yield which was significantly higher than the treatments with exception of T6, T11, T12 and T13.

This clearly indicates the much better residual effect of POLY-4. These findings were supported by Singh *et al.* (2008) and Panwar (2008).

Harvest index (%). Harvest index express proportion of economic yield in total biological yield did not differ significantly by the different treatments applied in previous crop and their residual effect on maize crop during the experimentation. Numerically maximum harvest index value (48.1%) was observed in RDF NP+ 150% of RDF K by MOP+150% of RDF S equal to T7 by Bentonite (T10) than rest of the treatments during year of study. Lowest harvest index (43.2%) was recorded in RDF NP and 100% of RDF K by POLY-4 (T6). These findings were supported by Mahala *et al.* (2006) and Panwar (2008).

CONCLUSION

From the result it was found that residual effect varied due to source of potassium application and in this study polyhalite was found better than MOP. Secondary, super optional application of K to preceding crop resulted in more residual effect therefore it may be concluded that nutrient management should be consider on cropping sequence basis rather than single crop and polyhalite may be a good source for potassium.

FUTURE SCOPE

In order to arrive at a meaningful recommendation, the further residual effect of applied nutrients to Potato on growth, yield attributes and yield on succeeding spring Maize (*Zea mays* L.) need to be reported for one more year. Alternatives for economizing production of polyhalite are in entases needed.

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Conflict of Interest. None

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