Comparative Efficiency of Various Potassium Extraction Procedures

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Abstract: A greenhouse study was undertaken to see the comparative efficiency of various potassium extraction procedures in three soil series of Pakistan i.e., the Shahdara, the Sultanpur and the Lyalipur. The data showed that number of tillers plant⁻¹, grain and straw yield of wheat was increased by the application of N and P fertilizers. Potassium concentration in grain and straw was decreased while its uptake increased with the application of N and P. Potassium release from the native reserves increased with the application of N and P. The amount of K extracted by HNO₃ was maximum followed by NH₄OAC, MgOAC, CaCl₂ and water in the descending order. Ammonium acetate gave best correlation between K uptake by wheat plants and K extracted by various chemical extractant when no fertilizer was applied while CaCl₂ proved best extractant when N and P fertilizers were applied. Quantity factor gave best correlation with K uptake at all levels of N and P fertilizers application rates when Quantity, Intensity and Quantity/Intensity relations were studied. In case of Electrodialfiltration (EUF) determination, the values of correlation coefficient (r) were significantly high when K was determined for 35 minutes EUF at control while, 10 minutes EUF at all N and P application rates. In all comparison of various procedures like water soluble, NH₄OAC, MgOAC, CaCl₂, HNO₃ EUF, Q, I and Q/I relations for determining the soil K status and its uptake by wheat plant showed that NH₄OAc gave the best correlation at zero application of N and P fertilizers, water soluble and CaCl₂ were found best when N₁₀₀ and P₁₀₀ dose were applied while EUF 10 minutes and CaCl₂ were good when N₂₀₀ and P₂₀₀ were applied. The activity ratio (Q/I) did not prove good parameters to measure the K availability status of the soils. Though the chemical extractant gave comparatively better correlation with K uptake but EUF method is a rapid and easy. So it should be used for routine work to get accurate and rapid results.

Keywords: K extraction, wheat crop, correlations

Introduction

The supply of potassium from soil depends on the quantities and forms present and the rate at which the exchangeable potassium is replenished from non-exchangeable sites. Mostly the amount of water soluble, exchangeable and non-exchangeable forms of K are used to evaluate K supply to the plants and their uptake. The amount of potassium released to the plants and by which extractants differs greatly. Amounts of potassium removed by NH₄OAc, HNO₃, HCl and NaB₄H₄ from soil prior to cropping generally correlate better with its uptake by plants, than did amounts of K removed by other extractant (Conyers and McLean, 1969). While Grime and Nemeth (1976) noted that K extracted by 0.025 N CaCl₂ was closely correlated with potassium concentration and they further emphasized on the advantage of EUF method that enable direct measurement of desorption and solubility rates. There are many other soil testing methods and a great deal of work has been expanded in the search for the “best” method. The various soil testing methods can be classified according to the fractions of soil K, which are recovered. Different forms of K are

(1) Water soluble K
(2) Exchangeable K
(3) Plant available K
(4) Non-exchangeable K
(5) Fixed K
(6) Released K

The ratio of K to (Ca + Mg) in the soil solution has been used by several workers to measure K availability in the soils. The quantity (Q) and the intensity factor (AR) proposed by Beckett (1964) a gave a better picture of the K supplying power of the soil than available K or the ionic activity ratio of K. The potential buffering capacity (PBC) combines in one parameter the quantity and intensity factor (Beckett, 1964ab). Soils having high PBC and low K and AR values are not responsive. The EUF method not only allows in the determination of intensity, quantity and buffering capacity (Nemeth, 1976 and Grime, 1980) but also allows as assessment of the changes of mobile soil K with time. While Purwanto and Sri Adiningishi (1980) reported that over fairly wide range of soils, not 1 HNO₃ had the highest correlation with rice yield and K uptake but also Morgan and Venema (10 % NaOAC + 3% CH₃COOH) gave correlation almost as high. The practice of soil testing for K in Pakistan consists of extracting the soils with neutral normal NH₄OAC, designating them low, medium or high on the basis of test estimations given by Tamhan and Subhish (1960) making fertilizers use recommendations in the light of available experimental data. The soils of Pakistan have still large capacity to provide K to crops under ordinary conditions but introduction of high yielding crop varieties and increased crop intensity have resulted in considerable drain of soil K reserves and need for K fertilization is becoming necessary (Mah et al., 1989). So there is a great need to determine total and available K in soil and its uptake by plants as influenced by various doses of N and P. Keeping this in view this study was conducted with the following objectives:

Comparison of different chemical extractant for potassium status in soil.

Availability of K by applying activity parameters i.e.,

\[ aK = \frac{a}{(Ca+Mg)^b} \]

Potassium supplying power of the soils as determined by EUF.

Potassium supplying power of the soils to wheat fertilized with various doses of N and P.

Materials and Methods

A pot experiment was conducted to determine the K status of various soil series of Punjab and its availability to wheat crop by applying nitrogen and phosphorus fertilizers. Six soil samples of three soil series viz the Shahdara, the Nabipur and the Lyalipur were collected with the technical assistance of soil Survey of Pakistan, Lahore from appropriate sites from 0-15 cm and 15-45 cm depth. These soil samples were air dried ground, passed through a 2 mm sieve and thoroughly mixed. Three kg of each sample was added to plastic pots and following treatments were applied.

\[ T_1 = \text{Control} \]
\[ T_2 = N_{100} \ P_{100} \, \text{kg ha}^{-1} \]
\[ T_3 = N_{200} \ P_{100} \, \text{kg ha}^{-1} \]

Wheat variety LU 26 S was sown and the system of layout was CRD with three replications. In this way 54 pots were used in this study. Crop was harvested at maturity, tillers plant⁻¹, grain and straw yield data were recorded. Grain and straw samples were analyzed for K contents by using method given in Handbook No. 60 (U.S.Salinity Lab. Staff, 1954) and K uptake was calculated by using the formula:

\[ \text{Potassium uptake mg kg}^{-1} = \frac{\text{Grain/Straw yield} \times K \text{ in Grain/Straw (%)}}{(g \text{ pot}^{-1})} \times 1000 \]

100 X 3

The original soil samples prior to filling in pots were analyzed for physical
and chemical characteristics (Table 1) according to the methods given in Handbook No. 60 (U.S. Salinity Lab. Staff, 1984) except texture by Moodie et al. (1959), total N in soil by Jackson (1952) and available P by Watanabe and Olsen (1965). Potassium was extracted by (I) Water (100 ml 1 N NaHCO₃ (U.S. Salinity Lab. Staff, 1984)(III) 0.5 N MgOAc (Conyers and McLean, 1969)(IV) 0.025 N CaCl₂ (Grimme and Nemeth, 1978) (V) 1 N HNO₃ (Knudsen et al., 1982) (VI) Quantile/Intensity relationships of exchangeable K/solution K = 1.01

\[(\text{Ca} + \text{Mg})^{2+}\]

(VII) K determination by electrophoresis EUF (Nemeth, 1972). EUF method is a combination of electro dialysis and ultra filtration of the cathode and anode dialyze at chosen voltages and temperature. The middle cell apparatus is used in EUF. The middle cell containing the soil suspensions, soil: water (1:10) has a strainer and a water inflow. Each side of this middle cell is provided with micro pore filter attached to the platinum electrode that separates the middle cell from the two cut side compartments. Therefore, the hydroxides (NaOH, KOH, Ca(OH)₂, NH₄OAc) accumulate at the cathode and the acids (H₂PO₄, H₂SO₄, etc.) accumulate at the anode are washed away by continuous stream of water to the collecting tank. The fraction is collected at 5 minutes or other intervals up to 35 minutes. The fraction 0-10 minutes is intensity, 0-35 quantity and 30-35 minutes is reserve K while ratio of 5-10: 30-35 minutes is potential buffering capacity (PBC). After the harvest of crop, soil samples were again analyzed for K by using 1 N NH₄OAc. Correlation was determined between K extracted by various procedures and K uptake by wheat plants (K uptake by grain + K uptake by straw) as described by Steel and Torrie (1980).

Results and Discussion

The data showed that all the soil series used were medium to fine in texture, non-saline, alkaline in reaction, low in total N and available P (Table 1) to supply adequate nutrient requirements of high yielding crops. The number of tillers plant⁻¹, grain and straw yield were maximum in Sultanpur sub soil while minimum in Lyaipur sub soil (Fig. 1, 2 and 3). As far as treatments are concerned, these parameters increased with increasing levels of N and P application in all the soils. A number of workers have also noted similar observations (Hayee and Amanullah, 1972 and Barheris, 1983). The K concentration in grain and straw was noted maximum in Sultanpur sub soil and minimum in Shahdara sub soil (Fig. 4 and 5). As far as treatments are concerned, K concentration decreased with the increasing rates of N and P fertilizers. The reason for decrease of K concentration might be dilution effects, the grain and straw yield was increased by adding N and P fertilizers resulting in decrease of K contents. Donovan and Brann (1984) also reported similar results. Potassium uptake by wheat plants increased in all the soil series in surface and sub soils except Sultanpur sub soil where it decreased then increased with the application of N and P fertilizers (Fig. 6). Although the K percentage in the plant material was less in N and P fertilized pots yet the total K uptake was higher which might be due to dilution effect by relatively more yield of dry matter (grain and straw). Potassium uptake by the plants was somewhat proportional to the amount of this element in the soil. Similar findings were depicted by Al-Rawi and Al-Mohammad (1979) and Mengel (1982). It can further be seen that K uptake in all the treatment was more from surface than that from sub soil except in the Shahdara surface soil in T₃ and Sultanpur sub soil in all the treatments. The reason might be that soil sample of Sultanpur series was taken from the sandy area where most of the K was leached down from surface to sub soil, so its extractable contents were more in sub soil than that in surface layer. Release of potassium from non-exchangeable K by applying N and P was considerable (Table 2) in spite of the fact that initial K status of all the soil samples ranged between satisfactory to adequate. More K was absorbed by plants from those pots to which N and P were applied. Post harvest analysis of the soils indicated that NH₄OAc extractable K decreased in all the soils except Sultanpur surface where it increased in T₃ but not in T₁ and T₂. It can very safely be concluded that if we increase the application of N and P, then uptake of K is increased and more K will come from native to exchange sites or to soil solution form. Grimme (1974) found that in many cases yields are reduced, if a large proportion of the K requirement has to be covered by non-exchangeable K, because the release rate may be too low to meet the K demand of vigorously growing crops. Similar results were reported by McLean (1978) and Salhern (1983).

Potassium was extracted by using five chemical extractant. The data showed that water extractable K was low as compared with other extractant (Table 3). The amount of K extracted by NH₄OAc was more than MgOAc, CaCl₂ because NH₄⁺ ion has almost the same sized that of K, so it enters into clay holes and extracts K while Ca²⁺ and Mg²⁺ have large size and cannot replace K from internal sites of 2:1 clay minerals. So less quantity is extracted by these extractant. All these three extract water soluble + exchangeable K. Therefore amounts of K extracted by these extractant is greater than only K extracted by water. The amounts of K determined by boiling 1 N HNO₃ are very high because it determines the non-exchangeable fraction of soil K. Conyers and McLean (1969) reported HNO₃ treatments had major expansion and dissolution effect on vermiculite and a component of an illite but had relatively small effects on Kaldinite, montmorillonite and a Brookston soil clay. Quantity (Q) and intensity (I) values were determined from primary data to see the K potential buffering capacity (PBC) of all these soil series. The maximum value of Q (ma 100 g⁻¹), I (AR (Mil)⁻¹) and Q/I (PBC) in Sultanpur sub soil (Table 4) while minimum Q and I was in Shahdara surface and Q/I in Sultanpur surface soil. According to Beckett (1984) b the factor Q and I gave a better picture of the K supplying power of a soil. The potassium was also determined by EUF which indicated that K desorption rate were similar in both surface and sub surface of the Shahdara series (Table 5, Fig. 7 and Fig. 8). The amounts of soil solution K (0-10 minutes) and exchangeable K (0-35 minutes) were adequate to supply K to wheat plants. The portion 30-35 minutes indicate that release of K from reserve was enough to supply K through out the growing period. The ratio between 5-10 and 30-35 minutes indicate the K released which was high and show a high K fixation capacity of these soils. In case of the Sultanpur soil series, the EUF fractions of K were different in surface and sub soil (Table 5, Fig. 9 and 10). In case of surface soil the supply would be constant through out the growing period and the reserve quantity and fixation capacity were high. In case of sub soil, the EUF curves indicate that the initial K status was very high but with the passage of time, the supply would decrease. This soil was also found to supply enough reserve K in very low amounts in comparison to exchangeable K (0-35 minutes). In case of the Lyaipur series, the EUF fractions of absorbed K were also different for surface and sub surface soil (Table 5, Fig. 11 and 12). The results indicated that the solution K was less while exchangeable K was more and its release rate was constant in surface layer. The ratio between 5-10 and 30-35 minutes indicates that K released which was very wide showing low K fixation capacity of this soil. In sub soil the K availability 1st increased then decreased indicating the need of K fertilizer application for greater and constant supply of K. This soil also has low K fixation capacity. Similar explanation for these data was given by Grimme (1980). Potassium extracted by all the five chemical extractant was positively correlated with the K uptake by wheat plants in all the treatments (Table 6). The maximum correlation coefficient value was 0.98 and minimum 0.026. Among all the extractant, K extracted by N NH₄OAc was highly correlated (r = 0.98) with K uptake by wheat in T₃ followed by MgOAc (r = 0.97), HNO₃ (r = 0.83) and water (r = 0.26) while at the T₃ water was highly correlated (r = 0.84) followed by CaCl₂ (r = 0.68), MgOAc (r = 0.67), NH₄OAc (r = 0.62) and HNO₃ (r = 0.45). At T₃ CaCl₂ gave maximum correlation value (r = 0.82) followed by MgOAc (r = 0.81), NH₄OAc (r = 0.74), water (r = 0.67) and HNO₃ (r = 0.49). These results are line with those of Grimme and Nemeth
Table 1: Physical and Chemical Characteristics of the Soils

<table>
<thead>
<tr>
<th>Soil Series</th>
<th>Depth (cm)</th>
<th>Texture</th>
<th>pHs</th>
<th>EC (d S m⁻¹)</th>
<th>EC (mg K g⁻¹)</th>
<th>Total N (%)</th>
<th>Available P (mg kg⁻¹)</th>
<th>Extractable K (mg K g⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shahdara</td>
<td>0-15</td>
<td>Clay loam</td>
<td>8.05</td>
<td>3.50</td>
<td></td>
<td>0.028</td>
<td>5.4</td>
<td>62.50</td>
</tr>
<tr>
<td>Shahdara</td>
<td>15-45</td>
<td>Sandy clay loam</td>
<td>8.02</td>
<td>1.20</td>
<td></td>
<td>0.020</td>
<td>7.0</td>
<td>60.00</td>
</tr>
<tr>
<td>Sultanpur</td>
<td>10-15</td>
<td>Loamy clay</td>
<td>7.93</td>
<td>1.60</td>
<td></td>
<td>0.040</td>
<td>6.50</td>
<td>81.25</td>
</tr>
<tr>
<td>Sultanpur</td>
<td>15-45</td>
<td>Loamy clay</td>
<td>8.12</td>
<td>1.50</td>
<td></td>
<td>0.036</td>
<td>7.40</td>
<td>205.00</td>
</tr>
<tr>
<td>Lyallpur</td>
<td>0-15</td>
<td>Silty clay loam</td>
<td>7.60</td>
<td>0.88</td>
<td></td>
<td>0.024</td>
<td>6.0</td>
<td>106.25</td>
</tr>
<tr>
<td>Lyallpur</td>
<td>15-45</td>
<td>Silty clay loam</td>
<td>8.10</td>
<td>1.30</td>
<td></td>
<td>0.038</td>
<td>8.0</td>
<td>75.00</td>
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Table 2: Release of Potassium

<table>
<thead>
<tr>
<th>Soil Series</th>
<th>Depth (cm)</th>
<th>Treatment</th>
<th>W Soluble</th>
<th>Exch.</th>
<th>Total Capacity</th>
<th>W Sol.</th>
<th>Exch.</th>
<th>Straw</th>
<th>Grain</th>
<th>Total</th>
<th>Release</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shahdara</td>
<td>0-15</td>
<td>T₀</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0.00</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>00</td>
</tr>
<tr>
<td>Shahdara</td>
<td>15-45</td>
<td>T₀</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0.00</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>00</td>
</tr>
<tr>
<td>Sultanpur</td>
<td>0-15</td>
<td>T₀</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0.00</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>00</td>
</tr>
<tr>
<td>Sultanpur</td>
<td>15-45</td>
<td>T₀</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0.00</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>00</td>
</tr>
<tr>
<td>Lyallpur</td>
<td>0-15</td>
<td>T₀</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0.00</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>00</td>
</tr>
<tr>
<td>Lyallpur</td>
<td>15-45</td>
<td>T₀</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0.00</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>00</td>
</tr>
</tbody>
</table>

Table 3: Potassium Extracted by Different Extractant (ppm)

<table>
<thead>
<tr>
<th>Soil Series</th>
<th>Water soluble</th>
<th>( I \text{ N HNO}_3 )</th>
<th>0.6 N MgOAc</th>
<th>0.025 N CaCl₂</th>
<th>1 N HNO₃</th>
</tr>
</thead>
<tbody>
<tr>
<td>(S₀)</td>
<td>25.47</td>
<td>62.50</td>
<td>55.00</td>
<td>50.00</td>
<td>866.40</td>
</tr>
<tr>
<td>(S₅)</td>
<td>3.55</td>
<td>60.00</td>
<td>50.00</td>
<td>45.00</td>
<td>800.00</td>
</tr>
<tr>
<td>(S₁₀)</td>
<td>8.89</td>
<td>81.25</td>
<td>58.25</td>
<td>56.25</td>
<td>912.00</td>
</tr>
<tr>
<td>(S₂₀)</td>
<td>14.14</td>
<td>205.00</td>
<td>187.50</td>
<td>135.00</td>
<td>1305.00</td>
</tr>
<tr>
<td>(S₄₀)</td>
<td>5.38</td>
<td>106.25</td>
<td>87.50</td>
<td>75.00</td>
<td>1330.00</td>
</tr>
<tr>
<td>(S₆₀)</td>
<td>2.96</td>
<td>75.00</td>
<td>60.00</td>
<td>43.75</td>
<td>880.00</td>
</tr>
</tbody>
</table>

Table 4: Quantity (Exchangeable potassium), Intensity (activity ratio) and Quantity/Intensity (Potential buffering capacity)

<table>
<thead>
<tr>
<th>Soil Series</th>
<th>Water soluble</th>
<th>( I \text{ AR (M/I)} )</th>
<th>( Q/I ) (PBC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(S₀)</td>
<td>0.0947</td>
<td>7.846 X 10⁻²</td>
<td>120.70</td>
</tr>
<tr>
<td>(S₅)</td>
<td>0.1441</td>
<td>1.00 X 10⁻²</td>
<td>144.10</td>
</tr>
<tr>
<td>(S₁₀)</td>
<td>0.1857</td>
<td>1.962 X 10⁻²</td>
<td>94.65</td>
</tr>
<tr>
<td>(S₂₀)</td>
<td>0.4657</td>
<td>3.768 X 10⁻²</td>
<td>129.35</td>
</tr>
<tr>
<td>(S₄₀)</td>
<td>0.2562</td>
<td>2.272 X 10⁻²</td>
<td>113.64</td>
</tr>
<tr>
<td>(S₆₀)</td>
<td>0.1944</td>
<td>1.707 X 10⁻²</td>
<td>108.03</td>
</tr>
</tbody>
</table>

Table 5: K Determined by EUF (ppm)

<table>
<thead>
<tr>
<th>Soil Series</th>
<th>Depth (cm)</th>
<th>10 min.</th>
<th>35 min.</th>
<th>31-35 min.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shahdara</td>
<td>0-15</td>
<td>12.5</td>
<td>37.6</td>
<td>4.2</td>
</tr>
<tr>
<td>Shahdara</td>
<td>15-45</td>
<td>12.6</td>
<td>37.6</td>
<td>4.2</td>
</tr>
<tr>
<td>Sultanpur</td>
<td>0-15</td>
<td>12.5</td>
<td>49.9</td>
<td>4.2</td>
</tr>
<tr>
<td>Sultanpur</td>
<td>15-45</td>
<td>74.7</td>
<td>182.7</td>
<td>33.2</td>
</tr>
<tr>
<td>Lyallpur</td>
<td>0-15</td>
<td>24.9</td>
<td>54.1</td>
<td>4.2</td>
</tr>
<tr>
<td>Lyallpur</td>
<td>15-45</td>
<td>9.4</td>
<td>37.6</td>
<td>8.3</td>
</tr>
</tbody>
</table>

Table 6: Correlation coefficients of K uptake by wheat crop and K Removal by Various K extractant from soils in all treatments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Water soluble</th>
<th>( \text{NH}_4\text{OAC} )</th>
<th>MgOAc</th>
<th>CaCl₂</th>
<th>HNO₃</th>
<th>( Q/K ) (m²/100 mg)</th>
<th>( I \text{ AR (M/I)} )</th>
<th>( Q/I ) (PBC)</th>
<th>( * \text{ Significant at 5% level of probability} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₀</td>
<td>0.959</td>
<td>0.959</td>
<td>0.959</td>
<td>NS</td>
<td>NS</td>
<td>0.959</td>
<td>0.959</td>
<td>0.959</td>
<td>NS</td>
</tr>
<tr>
<td>T₁</td>
<td>0.650</td>
<td>0.650</td>
<td>0.650</td>
<td>NS</td>
<td>NS</td>
<td>0.650</td>
<td>0.650</td>
<td>0.650</td>
<td>NS</td>
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<tr>
<td>T₂</td>
<td>0.826</td>
<td>0.815</td>
<td>0.815</td>
<td>NS</td>
<td>NS</td>
<td>0.826</td>
<td>0.815</td>
<td>0.826</td>
<td>NS</td>
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</table>

Table 7: Coefficient correlations of K uptake by wheat crop versus Q, I and Q/I in soils in all the treatments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Q/K (m²/100 mg)</th>
<th>I/AR (M/I)</th>
<th>Q/I (PBC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₀</td>
<td>0.959</td>
<td>0.959</td>
<td>0.959</td>
</tr>
<tr>
<td>T₁</td>
<td>0.650</td>
<td>0.650</td>
<td>0.650</td>
</tr>
<tr>
<td>T₂</td>
<td>0.826</td>
<td>0.815</td>
<td>0.826</td>
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</table>

Table 8: Coefficient correlations of K determined by EUF and K uptake by wheat plants

<table>
<thead>
<tr>
<th>Treatment</th>
<th>10 min.</th>
<th>35 min.</th>
<th>31-35 min.</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₀</td>
<td>0.959</td>
<td>0.959</td>
<td>0.959</td>
</tr>
<tr>
<td>T₁</td>
<td>0.650</td>
<td>0.650</td>
<td>0.650</td>
</tr>
<tr>
<td>T₂</td>
<td>0.826</td>
<td>0.815</td>
<td>0.826</td>
</tr>
</tbody>
</table>

* = Significant at 5% level of probability. NS = Non-significant

(1976), Al-Ravi and Al-Mohammadi (1979) and Purwanto and Sri Adiningsih (1980). With the help of regression equations (1, 2, 3, 4) developed for maximum (r) value at each treatment, it is possible to tell how much will be the K uptake (y) by wheat if K extracted (x) by \( \text{NH}_4\text{OAC} \) when no fertilizer is to be applied, water and CaCl₂ extractable K (x) when \( N_{150} K_{100} \) are to be applied and CaCl₂.
Mehdi et al.: Efficiency of K extraction procedures

Fig. 1: Number of Tillers plant\(^{-1}\)

Fig. 2: Grain yield (g pot\(^{-1}\))

Fig. 3: Straw yield (g pot\(^{-1}\))

Fig. 4: Potassium in grains (%)

extractable K (x) if N\(_{60}{P}_{100}\) are to be applied. The correlation data between Q, I, Q/I and K uptake by wheat plants (Table 7) showed that Q gave maximum correlation. With K uptake by wheat plant followed by I and least by Q/I. The correlation coefficient (r) between Q, I and K uptake by wheat was positive and significant at T\(_1\) while at T\(_2\), T\(_3\), Q, I and PBC have non-significant positive correlation. Similar results were noted by MacLean (1961) and Munn and MoLean (1975). Regression equations were also computed for Q to calculate K uptake if Q is determined. However, under the conditions of this study the Q/I parameters of the soil seem to offer no advantage for predicting plant available K over the chemical extractant used. The correlation between K uptake and K concentration of soil solution determined by EUF was positive and significant (Table 8) at T\(_1\) (r = 0.958) and T\(_3\) (r = 0.826) but non-significant positive at T\(_3\) (r = 0.660). Similarly

Fig. 5: Potassium in straw (%)

Fig. 6: Potassium Uptake (mg/kg)

Fig. 7: K Determined by EUF (ppm)

Fig. 8: K desorption rate in shahdara series

10
The sultanspur series
AP (0-15 cm)

Fig. 9: K Desorption in sultanspur series

The Sultanspur series
AP (15-45 cm)

Fig. 10: K Desorption in sultanspur series

The Lyalpur series
AP (0-15 cm)

Fig. 11: K Desorption in lyalpur series

The Lyalpur series
AP (15-45 cm)

Fig. 12: K Desorption in Lyalpur series

Mehdi et al.: Efficiency of K extraction procedures

e ratio for determining the soil K status and its uptake by wheat plant showed that NH₄OAC is best when no fertilizer to be applied, CaCl₂ is best when N and P fertilizers to be applied. The activity ratio did not prove a good parameter to measure the K availability status of soil. Though the chemical extractant gave comparatively better correlation with K uptake but EUF method is rapid and easy. So it should be used for routine work to get accurate and rapid results.

References
