# WHEAT PHENOLOGY AND DENSITY AND FRESH AND DRY WEIGHT OF WEEDS AS AFFECTED BY POTASSIUM SOURCES LEVELS AND TILLAGE PRACTICES

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ABSTRACT

An experiment was conducted to evaluate the effect of potassium sources, levels and tillage practice on wheat phenology, weeds density, fresh and dry weight at New Developmental Farm, The University of Agriculture Peshawar during Rabi 2012. Randomized Complete Block (RCB) design with split plot arrangement having three replications was used. Tillage practices (chisel plough, mould board plough and rotavator) were allotted to main plots while K sources (Sulphate of Potash-SOP and Muriate of Potash-MOP) with levels (30, 60, 90, and 120 kg $ha^{-1}$) were applied to sub plots. Among different tillage systems, rotavator has significantly increased weed density (54 weeds $m^{-2}$), weeds fresh weight (98 $gm^{-2}$) and dry weight (65 $gm^{-2}$) as compared to mould board and chisel plough. SOP has significantly delayed anthesis(138 days), grain fill duration (29 days) and physiological maturity (167 days) were taken by subplots which received K in the form of sulphate of potash (SOP). While in case of potassium levels maximum days to anthesis (140), grain fill duration (29) and physiological maturity (168) were counted for K applied at the rate of 120 kg $ha^{-1}$. Control plot had resulted minimum values for all aforesaid parameters. It is concluded from the experiment that rotavatorhad increased weeds density, fresh and dry weight. However, on the other hand chisel plough had significantly reduced weed density, fresh and dry weight. It is therefore, chisel plough and SOP at the rate of 60 kg $ha^{-1}$ is recommended to control weeds and delay wheat phenology.

Keywords:Phenology, physiology,potassium, tillage, weeds density.

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## INTRODUCTION

Wheat (TriticumaestivumL.)is the leading food grain of Pakistan and being the staple diet of the people. Is the key cereal crop in Pakistan and is adapted to a wide range of soil and climatic conditions. It supplies the major dietary requirements, i.e. 60% of the calories and protein of the average diet (Khalil and Jan, 2002). It occupies a central position in agricultural policies. During 2016-17, in Pakistan wheat was grown on area of 8900.7 hectare and total production was 25214 tons with an average yield of 2833 kg $ha^{-1}$ (Economic Survey of Pakistan, 2016-17). While in Khyber Pakhtunkhwa, the wheat sown area was 725 hectare with a total production of 1156 tons and average yield was 1595 kg $ha^{-1}$ (MINFA, 2010-11). Low yield of wheat crop per unit area in Khyber Pakhtunkhwa and Pakistan as a whole is attributed to the lack of availability of quality seeds of high yielding varieties, lack of plant protection measures, improper use of cultural practices and chemical fertilizers.

Tillage is the mechanical manipulation of soil and a tillage system is the sequence of operations that manipulates the soil to produce a crop(Muqaddaset al., 2005).Tillage is considered the most effective farm activity, improves the physical conditions of soil, which lead to an enhanced nutrient uptake and better yield of crops (Bahadaret al.,2007). Many researchers have reported that deep tillage (DT) or conventional tillage (CT) practices improve aeration (Zorita, 2000), soil porosity (Haoet al., 2001), conserve soil moisture and nutrients for plant and microbes (Patil et al., 2006). More grain yield (9%) and biomass (27%) in maize (Zorita, 2000) were achieved in DT or CT practices (Zorita, 2000). In contrast, minimum tillage (MT) have greater plant emergence, delayed wheat phenology, grain N and lower grain moisture (Basiret al., 2016, Wiatraket al., 2006). Deep tillage can effectively controlled weeds hence, more moisture will be available intern nutrients will be dissolve and become available for crop growth which will increase yield (Mushtaqet al., 2015). Tillage with moldboard plough gives 16% increase in yield as compared to common cultivator (Khan et al.,1990).Conventional tillage, significantly produce highest biological yield as compared to reduced tillage or no tillage which showed less biological and grain yield due to higher weed density (Gulet al., 2009).Plant height was increased due to sub soiling up to depth of 50 - 55 cm and consequently about 9.7% - 13.5% increase in maize yield (Borgheiet al., 2008). Similarly deep ploughing with chisel plough gave higher grain yield in maize as compared with mouldboard plough (Wasayaet al., 2011).

In Pakistan due too many constrains, the production potential of crop is not being dominated well enough, proper supply of nutrients is of much importance in this regard (Oadet al., 2004). Similarly, poor fertility status of our soils is another important cause of low productivity. So, the chemical fertilizer use come into view as the quickest and easiest way for increasing agricultural production in soil where nutrient is in deficient quantity.Potassium is considered one of the macro nutrient required for normal growth of the plants. It performs a number of key functions within plant body. Its function is well seen in photosynthesis, carbohydrates, starch formation, enabling crop plant to build up tolerance to drought conditions and improving plant capacity to resist (Tahiret al., 2008).

The use of K fertilizer in Pakistan is profitable (Saleem and Bertilsson, 1980). Commonly, there are two sources of K used as fertilizers i.e. sulphate of potash ($K_2SO_4$) and muriate of potash (KCl). Potassium chloride is a cheaper source of K as compared to potassiumsulphate but still its use is considered inappropriate in Pakistan due to the fear of adverse $Cl^-$ effects on plant growth (Khan,1985).Chloride applied in the form of muriate of potash did not show any adverse effect on the growth and yield of wheat (Sultan, 1985).Potassium showed a starring role in maximizing crop yield of various crops like wheat, rice, maize and cotton

and enhanced the quality of fruits and vegetable (Mengel and Kirby, 1987). Keeping in view the importance of tillage and potassium a field experiment was conducted on the title wheat phenology, weeds density, fresh and dry weight as affected by potassium sources, levels and tillage practice.

## MATERIALS AND METHODS

This study pertaining to "wheat phenology, weeds density, fresh and dry weight as affected by potassium sources, levels and tillage practice"was conducted at New Developmental Farm the University of Agriculture Peshawar Pakistan, during Rabi 2012. The experiment was laid out in randomize complete block design (RCBD) with split plot arrangement having three replications. Plot size was kept (3 m× 3 m).Whichaccommodate 10 rows with 30 cm row to row distance. Wheat variety siran 2010 was sown. A basal dose of N and P was used at the rate of 120 and 90 kg $ha^{-1}$ from urea and single super phosphate and four levels of K along with control. Nitrogen was applied in split doses while P and K were applied at the time of sowing. Deep, conventional and reduce tillage was carried out by chisel, mould board plough and rotavator respectively. Factor A consists of tillage practices (Chisel Plough 45 cm, Mould board plough 30 cm andRotavator 15 cm)was allotted to main plots while the factor B consists of K levels (30, 60, 90, and 120 kg $ha^{-1}$) and factor C consists of K sources (Sulphate of Potash50 % $K_2O$ and Muriate of Potash 60 % $K_2O$) were allotted to subplots.

Weed density $m^{-2}$ at three randomly selected places in each subplot was counted with the help of a quadratic (0.05 m × 0.05 m). Weeds fresh weight was recorded by harvesting all the weeds inside the quadratic ring at three locations in each plot, weighed and their mean was worked out. The weeds collected/harvested for fresh weight were dried in oven at 105 $^0$C for 24hrs, and weighed for weeds dry weight.Average was computed for each subplot and data was converted to weed density $m^{-2}$(Adnan et al., 2016). Number of days to anthesis was recorded when 75% spikes emerged in each subplot.Grain fill duration was recorded by counting the number of days between anthesis and physiological maturity. Days to physiological maturity data was recorded by taking the difference (in days) between sowing day and when 50% plants become physiologically mature.For plant height, five plants were selected randomly in each subplot and average height was calculated(Basiret al., 2016).

## STATISTICAL ANALYSIS

Statistical analysis of the data was done by the method designed for randomized complete block design with split plot arrangement. For different means comparisons LSD test was used at 5% level of probability when F values are significant (Steel and Torri, 1980).

## RESULTS AND DISCUSSION

### Weed density ($m^{-2}$)

Potassium sources, levels and control vs rest comparisonand all interactionshad non-significantly affected weed density $m^{-2}$while the effect of tillage practices was significant (Table 1). Maximum weed density $m^{-2}$ was counted for rotavator (54) followed by mould board plough (35) while minimum weeds density $m^{-2}$ (27) was counted for chisel plough.Reason is weeds compete for light, water; nutrients with plants and tillage practices significantly reduce weed density. Our result is similar with the finding of (Zorita, 2000) counted lower weed density in CT and DT compared to RT. soil covered up the weed seed in CT & DT while not do same in RT so that is why maximum weed density was counted because of the reduce leaching and high water holding capacity and less disturbance of weeds seed (Cardinaet al., 1991) and/or eradication of weeds. (Gill and Arshad, 1995) counted minimum weeds in mould board and chisel plough compared to rotavator.

Table.- 1. Weed density $m^{-2}$ of wheat as affected by K sources, levels and tillage practices

| K Levels | K Sources | Chisel plough | Mould board plough | Rotavator | L x S |
|---|---|---|---|---|---|
| 30 | SoP | 27 | 37 | 54 | 39 |
| | MoP | 28 | 36 | 55 | 40 |
| 60 | SoP | 20 | 34 | 56 | 37 |
| | MoP | 21 | 33 | 53 | 36 |
| 90 | SoP | 28 | 35 | 53 | 38 |
| | MoP | 29 | 35 | 52 | 39 |
| 120 | SoP | 31 | 37 | 52 | 40 |
| | MoP | 30 | 36 | 53 | 40 |
| | SoP | 26 | 36 | 54 | 39 |
| | MoP | 27 | 35 | 53 | 38 |
| 30 | | 27 | 37 | 54 | 39 |
| 60 | | 21 | 33 | 55 | 36 |
| 90 | | 28 | 35 | 53 | 39 |
| 120 | | 31 | 37 | 53 | 40 |
| | | 27c | 35b | 54a | |
| | Control | 22 | 39 | 51 | 37 |
| | Rest | 27 | 35 | 54 | 39 |

LSD value ($P \leq 0.05$) for tillage = 2.91

Weed fresh weight($gm^{-2}$)

Tillage practices and control vs rest comparison had significantly affected weed fresh weightwhile the effect of K sources, levels and all interactions was non-significant (Table 2). Maximum weed fresh weight (98 $gm^{-2}$)was counted for rotavatorfollowed by mould board plough (72$gm^{-2}$) while minimum weed fresh weight (64 $gm^{-2}$) was counted for chisel plough.Control plots counted minimumweed fresh weight (71 $gm^{-2}$) when compared to rest (78 $gm^{-2}$).The possible reason for the increase in weed fresh weight is that weeds compete for light, water and nutrients with plants and thus shallow tillage significantly increased water and thus nutrients availability. Our resultsare similar with the finding of Zorita, (2000) and Gill and Arshad, (1995) who counted lower weed fresh weight in CT and DT compared to RT. Soil covered up the weed seed in CT & DT while not do same in RT so that is why maximum weed fresh weight was counted because of the reduce leaching and high water holding capacity and less disturbance of weeds seed.

Table. 2. Weed fresh weight($gm^{-2}$) of wheat as affected by K sources, levels and tillage practices

| K Levels | K Source | Chisel plough | Mould board plough | Rotavator | L x S |
|---|---|---|---|---|---|
| 30 | SoP | 63 | 74 | 98 | 79 |
| | MoP | 65 | 73 | 99 | 78 |
| 60 | SoP | 57 | 71 | 101 | 76 |
| | MoP | 58 | 70 | 97 | 75 |
| 90 | SoP | 65 | 72 | 98 | 78 |
| | MoP | 66 | 72 | 96 | 78 |
| 120 | SoP | 68 | 74 | 97 | 80 |
| | MoP | 67 | 73 | 97 | 79 |
| | SoP | 63 | 73 | 98 | 78 |
| | MoP | 62 | 72 | 97 | 76 |
| 30 | | 64 | 74 | 98 | 76 |
| 60 | | 58 | 70 | 99 | 78 |
| 90 | | 65 | 72 | 97 | 79 |
| 120 | | 67 | 74 | 97 | 79 |
| | | 64c | 72b | 98a | |
| | Control | 59 | 69 | 95 | 71b |
| | Rest | 64 | 72 | 98 | 78a |

LSD value (P ≤ 0.05) for tillage = 3.17
LSD value (P ≤ 0.05) for control vs rest = 4.02

Weed dry weight($gm^{-2}$)

Tillage and control vs rest comparison had significantly affected weed dry weight while K sources, levels and all interactionshad non-significantly affected weed dry weight(Table 3). Maximum weed dry weight $gm^{-2}$(65 $gm^{-2}$)was counted for rotavatorfollowed by mould board plough (35 $gm^{-2}$) while minimum weed dry weight (24$gm^{-2}$) was counted for chisel plough.Control plots counted minimum weed dry weight (36 $gm^{-2}$). Reason is weeds compete for light, water; nutrients with plants and thus tillage practices significantly increased water so more nutrients available and thus increase weeds dry weight. Our result is similar with the finding of (Zorita, 2000) counted lower weeddry weight in CT and DT compared to RT. soil covered up the weed seed in CT & DT while not do same in RT so that is why maximum weed dry weight was counted because of the reduce leaching and high water holding capacity and less disturbance of weeds seed. Gill and Arshad, (1995) counted minimum weedsdry weight in mould board and chisel plough compared to rotavator.

Table. 3. Weed dry weightgm$^{-2}$ of wheat as affected by K sources, levels and tillage practices

| K Levels | K Source | Chisel plough | Mould board plough | Rotavator | L x S |
|---|---|---|---|---|---|
| 30 | SoP | 18 | 33 | 64 | 38 |
| | MoP | 19 | 34 | 60 | 38 |
| 60 | SoP | 17 | 34 | 68 | 40 |
| | MoP | 25 | 35 | 65 | 41 |
| 90 | SoP | 26 | 35 | 63 | 41 |
| | MoP | 23 | 37 | 65 | 42 |
| 120 | SoP | 25 | 36 | 66 | 42 |
| | MoP | 27 | 36 | 64 | 42 |
| | SoP | SoP | 23 | 36 | 65 |
| | MoP | MoP | 21 | 34 | 63 |
| 30 | | 18 | 33 | 66 | 39 |
| 60 | | 25 | 35 | 64 | 41 |
| 90 | | 24 | 37 | 65 | 42 |
| 120 | | 27 | 37 | 64 | 43 |
| | | 24c | 35b | 65a | |
| | Control | 19 | 33 | 58 | 36b |
| | Rest | 24 | 35 | 65 | 41a |

LSD value ($P \leq 0.05$) for tillage = 3.24
LSD value ($P \leq 0.05$) for control vs rest = 3.56

Days to anthesis

. Potassium sources, levels, and control vs rest comparison had significantly affected days to anthesis while tillage practices had no significant effect also all interactions were non-significant (Table 4). Between potassium sources maximum number of days (138) to anthesis was counted for MoP. In case of potassium levels those sub plots which received K at 120 kg ha$^{-1}$ took maximum (140) days to anthesis. Control plots took minimum days (135) to anthesis.It is due to high dose of fertilizer especially chloride which reduce chlorophyll content which intern reduce photosynthesis and ultimately growth and yield was reduced. Similar result was obtained by (Zehleret al.,1981) investigated that higher amount of chloride reduce chlorophyll and ultimately delay growth and flowering.

Table 4. Days to anthesis of wheat as affected by K sources, levels and tillage practices

| K Levels | K Source | Chisel plough | Mould board plough | Rotavator | L x S |
|---|---|---|---|---|---|
| 30 | SoP | 136 | 135 | 135 | 135 |
| | MoP | 139 | 138 | 137 | 138 |
| 60 | SoP | 135 | 135 | 132 | 134 |
| | MoP | 138 | 137 | 135 | 137 |
| 90 | SoP | 137 | 136 | 132 | 135 |
| | MoP | 140 | 136 | 136 | 138 |
| 120 | SoP | 140 | 139 | 135 | 138 |
| | MoP | 143 | 142 | 139 | 141 |
| | SoP | 137 | 136 | 133 | 135b |
| | MoP | 140 | 138 | 137 | 138a |
| 30 | | 137 | 136 | 136 | 137b |
| 60 | | 137 | 136 | 133 | 135c |
| 90 | | 139 | 136 | 134 | 136bc |
| 120 | | 141 | 140 | 137 | 140a |
| | | 139 | 137 | 135 | |
| | Control | 135 | 135 | 134 | 135b |
| | Rest | 139 | 137 | 135 | 137a |

LSD value (P ≤ 0.05) for levels = 1.45
LSD value (P ≤ 0.05) for control vs rest = 1.23
LSD value (P ≤ 0.05) for source = 1.36

Grain fill duration

Potassium sources, levels, and control vs rest comparison had significantly affected grain fill duration while non-significant effect was observed for tillage practices also all interactions were non-significant for grain fill duration (Table 5). Regarding K source maximum days (29) was counted for MoP. Obtained data on K levels clarify that maximum days for grain fill duration (29) were counted for K at 90 &120 kg $ha^{-1}$. While minimum days (27) were counted for K levels used at 30 & 60 kg $ha^{-1}$. Control plots took minimum days (25).It is due to high dose of fertilizer especially chloride which reduce chlorophyll content which intern reduce photosynthesis and ultimately growth and yield was reduced. Similar result was obtained by (Zehleret al.,1981) investigated that higher amount of chloride reduce chlorophyll and ultimately delay growth and flowering.

Table 5. Days to grain fill duration of wheat as affected by K sources, levels and tillage practices

| K Levels | K Source | Chisel plough | Mould board plough | Rotavator | L x S |
|---|---|---|---|---|---|
| 30 | SoP | 27 | 27 | 25 | 26 |
| | MoP | 30 | 29 | 27 | 29 |
| 60 | SoP | 27 | 25 | 24 | 26 |
| | MoP | 31 | 28 | 27 | 29 |
| 90 | SoP | 28 | 27 | 27 | 27 |
| | MoP | 31 | 30 | 28 | 30 |
| 120 | SoP | 30 | 28 | 27 | 28 |
| | MoP | 32 | 30 | 29 | 30 |
| | SoP | 28 | 27 | 26 | 27b |
| | MoP | 31 | 29 | 28 | 29a |
| 30 | | 29 | 28 | 26 | 27b |
| 60 | | 29 | 27 | 26 | 27b |
| 90 | | 30 | 29 | 28 | 29a |
| 120 | | 31 | 29 | 28 | 29a |
| | | 30 | 28 | 27 | |
| | Control | 26 | 25 | 24 | 25b |
| | Rest | 30 | 28 | 27 | 28a |

LSD value (P ≤ 0.05) for source = 1.53
LSD value (P ≤ 0.05) for control vs rest = 1.71
LSD value (P ≤ 0.05) for level = 1.62

Days to physiological maturity

Potassium sources, levels, andcontrol vs rest comparison had significantlyaffecteddays to physiological maturity while the effect of tillage practices wasnon-significantalso all interactions were non-significant for the above parameter(Table 6). Regarding potassium sources those sub plots which received MoP as a sources of Ktook maximum (167) days. Among K levels those sub plots which received K at 120 kg $ha^{-1}$ took maximum days (168) to physiological maturity while minimum (164) days were counted for K used at 30 $kgha^{-1}$. Control plots took minimum days (160) to physiological maturity.It is due to high dose of fertilizer especially chloride which reduce chlorophyll content which intern reduce photosynthesis and ultimately growth and yield was reduced. Similar result was obtained by (Zehleret al.,1981) investigated that higher amount of chloride reduce chlorophyll and ultimately delay growth and flowering.

Table 6. Days to physiological maturity of wheat as affected by K sources, levels and tillage practices

| K Levels | K Source | Chisel plough | Mould board plough | Rotavator | L x S |
|---|---|---|---|---|---|
| 30 | SoP | 163 | 162 | 162 | 162 |
| | MoP | 169 | 166 | 162 | 166 |
| 60 | SoP | 163 | 160 | 161 | 161 |
| | MoP | 169 | 167 | 164 | 167 |
| 90 | SoP | 165 | 164 | 163 | 164 |
| | MoP | 170 | 167 | 164 | 167 |
| 120 | SoP | 170 | 164 | 163 | 166 |
| | MoP | 173 | 171 | 168 | 171 |
| | SoP | 165 | 163 | 162 | 163b |
| | MoP | 170 | 168 | 165 | 167a |
| 30 | | 166 | 164 | 162 | 164b |
| 60 | | 166 | 164 | 162 | 164b |
| 90 | | 168 | 165 | 163 | 165b |
| 120 | | 171 | 168 | 166 | 168a |
| | | 168 | 165 | 163 | |
| | Control | 161 | 162 | 161 | 161b |
| | Rest | 168 | 165 | 163 | 165a |

LSD value (P ≤ 0.05) for source = 2.53
LSD value (P ≤ 0.05) for levels = 2.46
LSD value (P ≤ 0.05) for control vs rest = 2.87

Plant height (cm)

Potassium sources, levels, tillage practices, control vs rest comparison as well as all interactions had no significant effecton plant height (Table 7). Statistically similar value for plant height was counted for chisel plough, mould board plough and rotavator. Similar result was also obtained by (Ghaffaret al.,199) who reported that both sources (SoP&MoP) none significantly increased plant height of rice and wheat crop also non significantly increased over control.

Table 7. Plant height (cm) of wheat as affected by K sources, levels and tillage practices

| K Levels | K Source | Chisel plough | Mould board plough | Rotavator | L x S |
|---|---|---|---|---|---|
| 30 | SoP | 106.14 | 106.76 | 106.88 | 106.59 |
| | MoP | 105.41 | 106.55 | 105.90 | 105.95 |
| 60 | SoP | 106.58 | 108.09 | 107.63 | 107.43 |
| | MoP | 106.21 | 107.00 | 106.52 | 106.57 |
| 90 | SoP | 106.00 | 107.40 | 107.87 | 107.09 |
| | MoP | 104.25 | 105.91 | 105.85 | 105.34 |
| 120 | SoP | 105.81 | 106.15 | 107.33 | 106.43 |
| | MoP | 105.03 | 105.23 | 105.77 | 105.34 |
| | Sop | 106.13 | 107.10 | 107.43 | 106.89 |
| | MoP | 105.23 | 106.17 | 106.01 | 105.80 |
| 30 | | 105.78 | 106.65 | 106.39 | 106.27 |
| 60 | | 106.39 | 107.54 | 107.07 | 107.00 |
| 90 | | 105.12 | 106.66 | 106.86 | 106.21 |
| 120 | | 105.42 | 105.69 | 106.55 | 105.89 |
| | | 105.68 | 106.64 | 106.72 | |
| | Control | 104.81 | 105.56 | 104.69 | 105.02 |
| | Rest | 105.68 | 106.64 | 106.72 | 106.34 |

n.s. Mean with in the column are non-significantly different at (P ≥ 0.0.5) by using LSD test.

## CONCLUSION

Results indicated thatrotavator had increased weeds density, fresh and dry weight. However, on the other hand chisel plough had significantly reduced weed density, fresh and dry weight. It is therefore suggested that chisel plough and SOP at the rate of 60 kg $ha^{-1}$ is recommended to control weeds and delay wheat phenology.

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