Research Article

Evaluation of Weeds Density for Local and Chinese Lines in Northern Pakistan Under Different Sowing Intervals

Bismillah Khan[1*], Muhammad Mehran Anjum[1,2*], Maaz Ullah[1], Izharullah[1], Aftab Ahmad[3] and Jawad Akbar[1]

[1]*Department of Agronomy, The University of Agriculture Peshawar, Khyber Pakhtunkhwa, Pakistan;* [2]*Pakistan Council of Scientific and Industrial Research (PCSIR), Botany Section, Lab Complex Peshawar, Khyber Pakhtunkhwa, Pakistan;* [3]*Department of Plant Breeding and Genetics, The University of Agriculture Peshawar, Khyber Pakhtunkhwa, Pakistan.*

Abstract | Climate change adversely affect the pattern of temperature and distribution of rainfall due to which the incidence of new weeds occurs which cause a serious threat to our main crops. A study was carried out on "Evaluation of weeds density for local and Chinese lines in northern Pakistan under different sowing intervals" during winter season 2020-2021. The experimental design was used randomized complete block (RCB) with split plot arrangement replicated thrice. Treatments were consisted of sowing dates (1st November, 16th November and 1st December 2020) and wheat lines (MY409-4, MY1617, MY1416, MY291-4, MY1501, MY1419 and MY902) with one local wheat check (PS-15). Sowing dates were assigned to the main plot and wheat lines to the sub plot. Results indicated that local check PS-15 resulted in higher weeds density (79.6 plants m^{-2}), (64.0 plants m^{-2}) and (39.6 plants m^{-2}) 30, 60 and 90 DAS, respectively. Similarly, local check PS-15 produced higher weeds fresh weight (219.6 g m^{-2}), (253.7 g m^{-2}) and (303.0 g m^{-2}) 30, 60 and 90 DAS, respectively. Moreover, weeds dry weight was recorded higher (61.3 g m^{-2}), (88.6 g m^{-2}) and (111.6 g m^{-2}) 30, 60 and 90 DAS in local cultivar PS-15, respectively. Regarding sowing dates, sowing on 1st November resulted in maximum weeds density (67.6 plants m^{-2}), (49.9 plants m^{-2}) and (31.2 plants m^{-2}), weeds fresh weight (209.0 g m^{-2}), (241.0 g m^{-2}) and (288.0 g m^{-2}) and weeds dry weight (51.0 g m^{-2}), (81.4 g m^{-2}) and (101.4 g m^{-2}) 30, 60 and 90 DAS as compared to late sown plots on 1st December. Conclusively, Local check PS-15 produced higher weeds density, weeds fresh weight and weeds dry weight for all tested intervals of weeds infestation while minimum weeds infestation was observed for Chinese elite line MY291-4. Likewise, plots sown earlier on 1st November resulted in increased in weeds density by 21% (30 DAS), 32% (60 DAS) and 30% (90 DAS) as compared to late sowing on 1st December and weed fresh weight was 9% (30 DAS), 13% (60 DAS) and 11% (90 DAS) higher on 1st November sowing than 1st December sowing. Whereas weeds dry weight was recorded 83% (30 DAS), 34% (60 DAS) and 15% (90 DAS) higher than late sowing on 1st December.

Received | February 04, 2023; **Accepted** | March 25, 2023; **Published** | March 30, 2023
***Correspondence** | Bismillah Khan and Muhammad Mehran Anjum, Department of Agronomy, The University of Agriculture Peshawar, Khyber Pakhtunkhwa, Pakistan; **Email:** bismillah@aup.edu.pk, mehrananjum@aup.edu.pk
Citation | Khan, B., M.M. Anjum, M. Ullah, Izharullah, A. Ahmad and J. Akbar. 2023. Evaluation of weeds density for local and Chinese lines in northern Pakistan under different sowing intervals. *Pakistan Journal of Weed Science Research,* 29(1): 37-45.
DOI | https://dx.doi.org/10.17582/journal.PJWSR/2023/29.1.37.45
Keywords | Wheat lines, Sowing dates, Climate change, Weeds density, Weeds fresh and dry weight

Introduction

Wheat (*Triticum aestivum* L.) is a major rabi season crop that is grown on both irrigated and rain fed areas and well adapted at temperate regions (Baloch *et al*., 2016; Jamali *et al*., 2016). China, India, United States of America, Russian Federation and Canada are major wheat producers worldwide. Among them, China is the largest producer of wheat and shares 16.9% of global wheat production followed by India. These major producer countries contribute more than half of global wheat production (Singh *et al*., 2010). Worldwide Pakistan rank is 8th in leading wheat producing countries (Khan *et al*., 2022a) and cover maximum cropped area as compared to other crops. Wheat is grown on 8.796 million hectares with the productivity of 25.8 million tons annually with an average yield of 2752 kg ha^{-1} in Pakistan (Tunio *et al*., 2016). The value-added share of wheat crop in agriculture is 9.1% and gross domestic product (GDP) is 1.7% (MNFS and R, 2018). About 72% of the nation daily caloric is fulfilled by wheat and its consumption are approximately 124 kg per year which is the highest in the world (Williams and Raza, 2015). Wheat is the most nutritious food which is rich in protein, vitamins, minerals and fiber (Afzal *et al*., 2013; Kumar *et al*., 2011).

Wheat yield in Pakistan is low and static from past several decades due to various physiological, agronomic and genetic factors. Among agronomic factors, planting time is one of the most important factors which limits wheat yield by affecting the time, duration of vegetative and reproductive stage of crops (El-Sarag and Ismaeil, 2015). Too early or late sowing affects germination, frequent death of embryo, growth, grain development and produce poor plants with weak root system due cold or heat injury which leads to reduction in yield (Baloch et al., 2012). In contrast, optimum planting time produce maximum yield due to longer duration of grain development and tillering, produce maximum number of tillers, number of spikes, grains $spike^{-1}$ and thousand grain weight (Tahir *et al*., 2009a; Anjum *et al*., 2021a). Ali *et al*. (2014) reported that wheat crop sown on 15th and 31th December caused reduction in yield by 27% and 52%, respectively, as compared to sowing on 1st November. Generally, delay in sowing a day from optimum time decreased grain yield by 1 percent, also increased the risk of crop failure by disease and pest attack (Gul *et al*., 2012). Grain yield of wheat can be increased by 10 to 30% through the management of planting time, environmental conditions and cultivars (Anjum *et al*., 2022b). The scope of planting time not only bound to environment but also has impact on insects, pest and diseases attack. Due to climate change the pattern of rainfall and temperature has been changed, so optimum planting time of wheat has postponed from late October to mid- November in recent past in Pakistan and expected to shift to early December (Awan *et al*., 2017).

Another important factor which is limiting wheat productivity in Pakistan is unavailability of high yielding and disease resistant varieties (El-Sarag and Ismaeil, 2015). The yield potential and average yield of our local cultivars in Pakistan is very low compared with other leading wheat producing countries. To meet the high demand of grains for the rapid growing population of Pakistan, it is the need of the day to identify such high yielding wheat varieties which can highly contribute yield per unit area and are adopted to our local environment. Grain yield is a complex trait which often rely on genotypic traits, yield components and different environmental condition (Khan et al., 2022a; Anjum *et al*., 2022b). Because yield is a polygenic character and thus can be enhanced by changing genetic characters and environment, the idea to increase yield components, varieties have received a great importance for improving actual yield (Khan *et al*., 2013b). Grain yield, biological yield and other yield components have direct relationship with improved varieties (Zulfiqar and Ashfaq, 2014; Ayaz, 2016). Concerning yield potential, the modern wheat genotypes have a huge variation which reveal that improved crop management can enhance grain yield (Laghari *et al*., 2012).

Even though in past the plant breeders and agronomist have developed many high yielding wheat genotypes for general cultivation but their performance is not as good as expected. There can be so many reasons for this failure but the well-known reason is that either these varieties have lost their potential adaptability to changing climate or have susceptibility to various fungal diseases like smut and rust (Khan et al., 2022a). The self-sufficiency in wheat can be obtained more specifically by growing the most appropriate varieties according to the climatic condition. Consequently, wheat varieties need continuous evaluation with wide range of adaptability or sensitivity and achieve the desirable traits to enhance the wheat production in

Pakistan.

Keeping in view the above mentioned factors this study was carried out to compare the Chinese wheat lines with elite local variety for yield and yield traits and to determine the optimum planting time for wheat lines under agro-ecological conditions of northern Pakistan.

Materials and Methods

Experimental site characteristics

A field experiment was conducted at Agronomy Research Farm, The University of Agriculture Peshawar, Pakistan during winter season 2020-2021. The experimental site is located at latitude (34.01° North), longitude (71.35° East) with an elevation of 331 meter above from mean sea-level. It exhibits subtropical climate with an average annual rainfall of 360 mm. The summer months i.e., May-September have an average higher temperature and lower temperature of 40°C and 25°C, respectively (Figure 1) whereas, winter months i.e. December-March have an average minimal temperature of 4°C and average maximal temperature of 18.4°C. The research farm is irrigated by Warsak river canal originated from Kabul River. The soil of the experimental site is slightly alkaline in reaction and silt clay loam in texture with most of the nutrients deficient in soil the (Table 1).

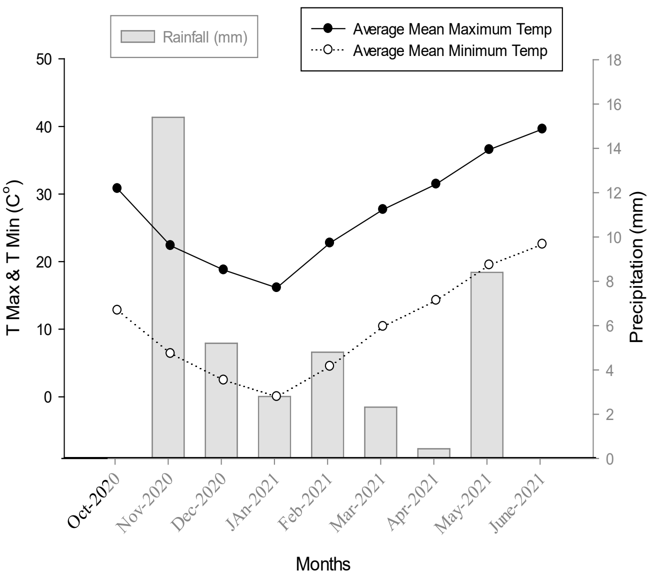

Figure 1: *Average mean monthly weather data of year 2020-2021 of experimental site for the crop growth season (Nov-May). Oct = October, Nov = November, Dec = December, Jan = January, Feb = February, Mar = March, Apr = April. (Source: Peshawar Meteorological Department).*

Table 1: *Physico-chemical properties of soil at the experimental site.*

Property	Values
pH	8.23
EC (dS m^{-1})	0.16
Sand (%)	8.67
Silt (%)	52.43
Clay (%)	38.90
Textural class	Silty clay loam
Bulk density (mg^{-3})	1.35
CEC ($cmol_c$ kg^{-1})	30.1
Total organic C (g kg^{-1})	12.7
Total N (g kg^{-1})	0.61
Total P (g kg^{-1})	0.24
Total K (g kg^{-1})	14.3
Available P (mg kg^{-1})	3.20
Available N (mg kg^{-1})	23.7
Available K (mg kg^{-1})	85.8

Weeds species

The wheat crop is infested by both the broad leaf and grass weeds but severe problem is possessed by the grass weeds. In the irrigated wheat condition among grass weeds *P. minor* and *A. fatua* and broad leaf weeds R. dentatus and Medicago denticulata are of significant concern.

Treatments and field research

The experiment was performed in randomized complete block deign (RCBD) with split plot arrangement having three replications. The experimental plot was 3 m x 4.5 m (13.5 m^2) with rows space of 30 cm accommodating 15 rows. The field was ploughed down using cultivator (which can plough to a depth of 10-15 cm) followed by rotavator (which can plough to a depth of 20 cm). Treatments were consisted of sowing dates (1st November, 16th November and 1st December 2020) and wheat lines (MY409-4, MY1617, MY1416, MY291-4, MY1501, MY1419 and MY902) with one local wheat check Pirsabak 2015 (PS-15). Main plots were allotted to sowing dates whereas sub plots were assigned to wheat lines. The crop was sown manually in rows through hand hoe with the seed rate of 120 kg ha^{-1}. Nitrogen and phosphorous were applied from urea and DAP source at the rate of 120 and 90 kg ha^{-1}, respectively. Nitrogen was applied in three splits i.e., 15% applied during seedbed preparation, 42.5% with first irrigation and 42.5% at tillering stage. All the phosphorous was applied at the time of seedbed preparation. Irrigation water was applied at proper growth stages considering the requirement of the crop and weather condition. Roguing was done for the removal of off types of plants from the field. The crop was reaped at harvest maturity when spikes color turned to brownish. The crop was kept in the field for sun drying and then threshed with mini thresher.

Table 2: *Common weeds species found in wheat.*

S. No	Species list	Family	English name
1	*Chenopodium album*	Amaranthaceae	Sweet clover
2	*Phalaris minor*	Poaceae	Canary grass
3	*Avena fatua*	Poaceae	Wild oat
4	*Cynodon dactylon*	Poaceae	Lawn grass
5	*Vicia sativa*	Fabaceae	Common vetch
6	*Convolvulus arvensis*	Convolvulaceae	Bind weed
7	*Fumaria parviflora*	Papavveraceae	Fineleaf fumitory
8	*Melilotus indicus*	Fabaceae	Sweet clover
9	*Amaranthus spinocus*	Amaranthaceae	Spiny amaranth
10	*Euphorbia hirta*	Euphorbiaceae	Asthma plant
11	*Spergula arvensis*	Caryophyllaceae	Stickwort
12	*Solanum nigrum*	Solanaceae	Black nightshade
13	*Polygonum plebeium*	Polygonaceae	Knotweed
14	*Stellaria media*	Caryophyllaceae	Chick weed
15	*Trifolium repens*	Fabaceae	White clover
16	*Rumex dentaus*	Polygonaceae	Toothed duck
17	*Malilotus alba*	Leguminaceae	Meal weed
18	*Xanthium strumarium*	Asteraceae	Clotbur

Plant parameters and analysis

Weeds density m^{-2} was recorded by throwing one-meter rod three times at each treatment randomly and counted different weeds number and converted to one-meter square. Weed was collected in a bag at one square meter area from each plot and fresh weight (g) was taken in the same day by digital balance. Weed was collected in one square meter area from each plot and then kept to sun light for one day, then kept in oven at 70 °C and take dry weight with the help of digital balance (Anjum *et al*., 2022b).

Statistical analysis

The collected data of various parameters were statistically analyzed as per procedure relevant for Randomize Complete Block Design with split plot arrangement. The treatment means were separated through LSD (Least Significant Differences) test at P ≤ 0.05 (Steel *et al*., 1997).

Table 3: *Weed density (plants m^{-2}) as influenced by wheat lines under varying sowing intervals.*

Wheat lines	Weeds density (plant m^{-2})		
	30 DAS	**60 DAS**	**90 DAS**
PS-15	79.6 a	64.0 a	39.6 a
MY409-4	63.8 ef	43.7 d	27.8 cd
MY1617	65.5 de	50.2 c	28.5 cd
MY1416	73.2 bc	59.0 b	35.2 b
MY291-4	60.4 f	38.5 e	24.4 d
MY1501	69.6 c	56.3 bc	33.6 bc
MY1419	76.0 b	61.8 ab	37.0 ab
MY902	66.0 d	47.7 cd	30.0 c
LSD(0.05)/Significance	3.5	4.4	3.9
Sowing dates			
1st November	67.6 a	49.9 a	31.2 a
16th November	61.3 b	45.6 b	27.5 b
1st December	55.9 c	37.7 c	24.0 c
LSD (0.05)/Significance	5	4.1	3.3
Interactions	ns	ns	ns

DAS = Days after sowing. Means in the same category having dissimilar alphabets vary significantly at 5% level of probability.

Results and Discussion

Effects on weeds density (plant m^{-2})

Data regarding weeds density 30, 60 and 90 days after sowing (DAS) are given in Table 3. Analysis of the data revealed that wheat lines (L) and sowing dates (SD) significantly affected weeds density at all intervals. The interaction between L and SD was not significant for all intervals. Data concerning 30 DAS, higher weeds density (79.6 plant m^{-2}) were recorded in local check PS-15 followed by line MY1419 (76.0 plant m^{-2}) while line MY291-4 resulted in lower weeds density (60.4 plant m^{-2}). Early sowing resulted in higher weeds density than late sowing. Maximum weeds density (67.6 plants m^{-2}) was noted in earlier planting on 1st November followed by 16th November (61.3 plants m^{-2}). Lower weeds density (55.9 plants m^{-2}) was noted in delayed planting on 1st December. Similarly, 60 DAS higher weeds density (64.0 plants m^{-2}) were recorded in local cultivar PS-15 which was statistically at par with line MY1419 followed by lines MY1416 (59.0 plants m^{-2}). Minimum weeds density (38.5 plants m^{-2}) was observed in line MY291-4. Wheat crop sown earlier resulted in more weeds density in comparison with late sowing. Higher weeds density (49.9 plants m^{-2}) was recorded in early sowing on 1st November followed by sowing on 16th November (45.6 plants m^{-2}) whereas lesser weeds density (37.7 plants m^{-2}) was noted in late sown plots on 1st December. Regarding 90 DAS, more weeds density (39.6 plants m^{-2}) was observed for local variety PS-15 which was statistically identical with line MY1419 followed by MY1416 (35.2 plants m^{-2}) whereas lowest weeds density (24.4 plants m^{-2}) was noted for line MY291-4. Early sown plots resulted in higher weeds density than delay sown plots. Crops sown earlier on 1st November resulted in maximum weeds density (31.2 plants m^{-2}) followed by plots sown on 16th November (27.5 plants m^{-2}) while lower weeds density were recorded on plots sown on 1st December (24.0 plants m^{-2}).

Effects on weeds fresh weight (g m^{-2})

Data concerning weeds fresh weight 30, 60 and 90 DAS are presented in Table 4. Analysis of the data revealed that wheat lines and sowing dates significantly affected weed fresh weight. The interaction between L and SD was not significant for all tested intervals. Data relating to 30 DAS, local variety PS-15 produced more weeds fresh weight (219.6 gm^{-2}) followed by line MY1419 (211.8 gm^{-2}). Lower weeds fresh weight (179.6 gm^{-2}) was recorded for line MY291-4. Late sowing produced lower weeds fresh weight whereas early sowing resulted in higher weeds fresh weigh. Sowing on 1st December resulted in lower weeds fresh weight (191.4 gm^{-2}) followed by sowing on 16th November (198.5 gm^{-2}) while early sowing on 1st November produced more weeds fresh weight (209.0 gm^{-2}). Likewise, 60 DAS maximum weeds fresh weight (253.7 gm^{-2}) was recorded for local check PS-15 followed by line MY1419 (245.7 gm^{-2}) while minimum weeds fresh weight (202.2 gm^{-2}) was recorded for line MY291-4. Late sown plots produced lesser weeds fresh weight while more weeds fresh weight was produced in early sown plots. Wheat crops sown on 1st November resulted in higher weeds fresh weight (241.0 gm^{-2}) followed by 16th November (227.8 gm^{-2}) sown plots. Late sown plots on 1st December resulted in lower weeds fresh weight (213.7 gm^{-2}). In case of 90 DAS, higher weeds fresh weight (303.0 gm^{-2}) was recorded for PS-15 followed by MY1419 (293.9 gm^{-2}) while lowest weeds fresh weight (259.3 gm^{-2}) was noted for line MY291-4. Late sowing resulted in lower weeds fresh weight while early sowing had higher weeds fresh weight. Minimum weeds fresh weight (259.4 gm^{-2}) was noted on late sowing at 1st December followed by sowing on 16th November (277.6 gm^{-2}). Higher weeds fresh weight was observed on early sowing on 1st November (288.0 gm^{-2}).

Table 4: *Weed fresh weight (gm $^{-2}$) as influenced by wheat lines under varying sowing intervals.*

Wheat lines	Weeds fresh weight (gm^{-2})		
	30 DAS	**60 DAS**	**90 DAS**
PS-15	219.6 a	253.7 a	303.0 a
MY409-4	183.4 de	209.4 ef	266.4 de
MY1617	193.3 cd	220.4 d	273.7 cd
MY1416	205.5 bc	239.1 bc	286.3 bc
MY291-4	179.6 e	202.2 f	259.3 e
MY1501	199.8 c	230.2 c	280.0 c
MY1419	211.8 b	245.7 b	293.9 b
MY902	188.0 d	212.5 e	268.6 d
LSD (0.05)/Significance	7.3	7.6	9
Sowing dates			
1st November	209.0 a	241.0 a	288.0 a
16th November	198.5 b	227.8 b	277.6 b
1st December	191.4 c	213.7 c	259.4 c
LSD (0.05)/Significance	7	11.7	10
Interactions	ns	ns	ns

DAS = Days after sowing. Means in the same category having dissimilar alphabets vary significantly at 5% level of probability.

Effects on weeds dry weight (gm^{-2})

Data concerning weeds dry weight 30, 60 and 90 DAS are presented in Table 5. Analysis of the data revealed that wheat lines and sowing dates significantly affected weed dry weight. The interaction between L and SD was not significant for all tested intervals. In case of 30 DAS, local variety PS-15 produced higher weeds dry weight (61.3 gm^{-2}) which was statistically at far with line MY1419 followed by line MY1416 and MY1501 (53.2 gm^{-2}) and (52.4 gm^{-2}) which was statistically identical with each other, respectively. Lower weeds dry weight (30.6 gm^{-2}) was recorded for line MY291-4. Early sowing produced higher weeds dry weight whereas late sowing resulted in lower weeds dry weigh. Sowing on 1st November resulted in higher weeds dry weight (51.0 gm^{-2}) followed by sowing on 16th November (96.3 gm^{-2}) while late sowing on 1st December produced less weeds dry weight (27.8 gm^{-2}). Similarly, 60 DAS maximum weeds dry weight (88.6 gm^{-2}) was recorded for local check PS-15 which was statistically similar with line MY1419 followed by line MY1416 (79.0 gm^{-2}) while minimum weeds dry weight (58.8 gm^{-2}) was recorded for line MY291-4 which was statistically in line with MY409-4. Late sown plots produced lesser weeds dry weight while more weeds dry weight was produced in early sown plots. Wheat crops sown on 1st November resulted in higher weeds dry weight (81.4 gm^{-2}) followed by 16th November (72.7 gm^{-2}) sown plots. Late sown plots on 1st December resulted in lower weeds dry weight (60.5 gm^{-2}). Moreover, 90 DAS higher weeds dry weight (111.6 gm^{-2}) was recorded for PS-15 which was statistically in line with line MY1419 followed by MY1416 (104.0 gm^{-2}) while lowest weeds dry weight (85.6 gm^{-2}) was noted for line MY291-4. Late sowing resulted in lower weeds dry weight while early sowing had higher weeds dry weight. Minimum weeds dry weight (87.9 gm^{-2}) was noted on late sowing at 1st December followed by sowing on 16th November (96.3 gm^{-2}). Higher weeds dry weight was observed on early sowing on 1st November (101.4 gm^{-2}).

Table 5: *Weed dry weight (gm $^{-2}$) as influenced by wheat lines under varying sowing intervals.*

Wheat lines	Weeds dry weight (gm $^{-2}$)		
	30 DAS	**60 DAS**	**90 DAS**
PS-15	61.3 a	88.6 a	111.6 a
MY409-4	36.8 d	63.5 d	92.9 cd
MY1617	45.3 c	70.2 c	96.3 c
MY1416	53.2 b	79.0 b	104.0 b
MY291-4	30.6 e	58.8 de	85.6 d
MY1501	52.4 b	74.1 bc	99.7 bc
MY1419	60.0 a	84.7 ab	107.8ab
MY902	41.3 cd	66.5 cd	93.8 cd
LSD (0.05)/Significance	6	6.7	7
Sowing dates			
1st November	51.0 a	81.4 a	101.4 a
16th November	40.8 b	72.7 b	96.3 b
1st December	27.8 c	60.5 c	87.9 c
LSD (0.05)/Significance	9.9	8.5	5
Interactions	ns	ns	ns

DAS = Days after sowing. Means in the same category having dissimilar alphabets vary significantly at 5% level of probability.

Significant variation was found among wheat lines and sowing dates for weeds density at different interval i.e. 30, 60 and 90 DAS. Regarding 30 DAS, local check PS-15 resulted in 5% higher weed density than line MY1419 which was produced 26 % higher weed density than line MY291-4. Early sowing on 1st November resulted in 10% higher weeds density than sowing on 16th November which was 10% higher than late sowing on 1st December. Similarly, 60 DAS local check PS-15 resulted in 8% higher weed density than line MY1416 which was produced 53 % higher weed density than line MY291-4. Early sowing on 1st November resulted in 9% higher weeds density than sowing on 16th November which was 21% higher than late sowing on 1st December. Moreover, 90 DAS local check PS-15 produced 14% higher weed density than line MY1416 which was produced 44 % higher weed density than line MY291-4. Early sowing on 1st November resulted in 13% higher weeds density than sowing on 16th November which was 15% higher than late sowing on 1st December. Awan *et al.* (2017) demonstrated that low weeds density may be due to low temperature which decreased rate of germination of weeds when sowing was done on 25th December. Another probable reason for variation in weeds density could be due to relatively high temperature at early planting on 15th October in comparison with delayed planting (Anjum *et al.*, 2022b). Khan et al. (2022a) stated that late sown wheat crop on 30th December faced the undesirable environmental condition at each developmental stage which reduced weeds infestation. Anwar *et al.* (2017) stated that variation in weeds density among cultivars might be associated to the genetic potential of cultivars to use the available resources efficiently for their growth and development. Tahir *et al.* (2009a) declared that differences was found in weeds density of among wheat genotypes due to its genotypic variability along with germination potential.

Significant variation was found among wheat lines and sowing dates for weeds fresh weight at different interval i.e. 30, 60 and 90 DAS. Regarding 30 DAS, local check PS-15 resulted in 4% higher weed fresh weight than line MY1419 which was produced 18 % higher weed fresh weight than line MY291-4. Early sowing on 1st November resulted in 5% higher weed fresh weight than sowing on 16th November which was 8% higher than late sowing on 1st December. Similarly, 60 DAS local check PS-15 resulted in 3% higher weed fresh weight than line MY1419 which was produced 21% higher weed fresh weight than line MY291-4. Early sowing on 1st November resulted in 8% higher weed fresh weight than sowing on 16th November which was 6% higher than late sowing on 1st December. Moreover, 90 DAS local check PS-15 produced 3% higher weed fresh weight than line MY1419 which was produced 13% higher weed fresh weight than line MY291-4. Early sowing on 1st November resulted in 4% higher weed fresh weight than sowing on 16th November which was 7% higher than late sowing on 1st December. These outcomes are in agreement with Mumtaz *et al.* (2015) who explained that maximal weeds fresh weight in early sowing on 1st November may be due optimum temperature required for better emergence which resulted in good growth and development at later stages. Similarly, delay in sowing from 1st November to 20th November decreased weeds fresh weight which might be due to decrease in temperature from optimum which adversely affected the growth of weeds (Aslani and Mehrvar, 2012). The possible reason for differences in weeds fresh weight among wheat varieties might be due to various factors such as nutrients availability in soil, weeds crop competition, existing environmental condition and genetic makeup of genotypes (Naveed *et al*., 2014).

Significant variation was found among wheat lines and sowing dates for weeds dry weight at different interval i.e. 30, 60 and 90 DAS. Data relating to 30 DAS, local check PS-15 resulted in 15% higher weed dry weight than line MY1416 which was produced 74% higher weed dry weight than line MY291-4. Early sowing on 1st November resulted in 25% higher weed dry weight than sowing on 16th November which was 47% higher than late sowing on 1st December. Similarly, 60 DAS local check PS-15 resulted in 12% higher weed dry weight than line MY1416 which was produced 35% higher weed dry weight than line MY291-4. Early sowing on 1st November resulted in 12% higher weed dry weight than sowing on 16th November which was 20% higher than late sowing on 1st December. Moreover, 90 DAS local check PS-15 produced 7% higher weed dry weight than line MY1416 which was produced 21% higher weed dry weight than line MY291-4. Early sowing on 1st November resulted in 5% higher weed dry weight than sowing on 16th November which was 10% higher than late sowing on 1st December. Tahir *et al.* (2019b) reported that reduction weeds dry weight in late sowingm ight be due to increase in temperature which reduce growing degree days, photosynthetic active radiation and source-sink relationship. Akhtar *et al.* (2006) concluded that late sown crop shortened the duration of each developmental stage which ultimately reduced the weeds dry weight. Mushtaq *et al.* (2011) also reported that differences in weeds dry weight among wheat cultivars could be due to their genetic potential.

Conclusions and Recommendations

Local check PS-15 produced higher weeds density, weeds fresh weight and weeds dry weight for all tested intervals of weeds infestation while minimum weeds infestation was observed for Chinese elite line MY291-4. Likewise, plots sown earlier on 1st November resulted in increased in weeds density by 21% (30 DAS), 32% (60 DAS) and 30% (90 DAS) as compared to late sowing on 1st December and weed fresh weight was 9% (30 DAS), 13% (60 DAS) and 11% (90 DAS) higher on 1st November sowing than 1st December sowing. Whereas weeds dry weight was recorded 83% (30 DAS), 34% (60 DAS) and 15% (90 DAS) higher than late sowing on 1st December. Keeping in view the conclusions of the research wheat lines MY291-4, MY409-4 and MY902 showed better performance against weeds infestation and compete very well with weeds for available resources like water, nutrients, light and space while sown on 1st December and is recommended for large scale cultivation in northern areas of Pakistan and similar condition elsewhere. Moreover, further research is suggested on Chinese elite wheat lines in prevailing changing climate to overcome the negative effect of weeds and to establish the current results.

Acknowledgement

The authors are thankful to researchers of Department of Agronomy, The University of Agriculture Peshawar and Pakistan Council of Scientific and Industrial Research, Labs Complex Peshawar-Pakistan, for their valuable feedback and assistance in the experiment designing and layout; and all the working staff of the who helped during this research.

Novelty Statement

The novelty of this research is to determine how different sowing intervals affect weeds density of indigenous and Chinese wheat varieties in northern region of Pakistan. This research may provide new insight into how planting timing affects weeds growth and may contribute to the development of more weeds control methods. A comparison of weeds density between local and Chinese wheat lines may also reveal new information about the variability of these cultivars for regional farming.

Author's Contribution

Bismillah Khan: Designed the experiments and wrote the first draft.

Muhammad Mehran Anjum: Measured the observations and analyzed the data.
Bismillah Khan, Muhammad Mehran Anjum and Maaz Ullah: Conducted this research.
Muhammad Mehran Anjum, Izharullah and Jawab Akbar Assisted in preparation of the draft of this paper.
Bismillah Khan, Aftab Ahmad: Proofread the article and finalized the draft.

Conflict of interest
The authors have declared no conflict of interest.

References

Afzal, S., A. Shehzad, M.A. Randhawa, A. Asghar, M. Shoaib and M.A. Jahangir. 2013. Health benefits and importance of utilizing wheat and rye. Pak. J. Food Sci., 23: 212-222.

Akhtar, M., M.S. Cheema, M. Jamil and L. Ali. 2006. Effect of time of sowing on some important characters of wheat (*Triticum aestivum* L.) genotypes. J. Agric. Res., 44: 255-259.

Ali, M.A., M. Ali and Q.M. Din. 2014. Determination of grain yield of different wheat varieties as influenced by planting dates in agroecological conditions of Vehari. Pak. J. Life Soc. Sci., 2(1): 5-8.

Anjum, M.M., M. Arif, N. Ali, B. Khan and G.R. Khan. 2021a. Chinese wheat hybrids 18A-1 and18A-2 surpass local check (Ghaneemat-2016) under deficit irrigation when sown early in semiarid climatic conditions. Springer.

Anjum, M.M., M. Arif, B. Khan, N. Ali and G.R. Khan. 2022b. Recalcitrance potential of wheat hybrids and local cultivar against yellow rust disease and weeds density under climatic condition of Peshawar, Khyber Pakhtunkhwa. Pak. J. Weed Sci. Res., 28(3): 243-251. https://doi.org/10.28941/pjwsr.v28i3.1054

Anwar, S., M. Faraz, M. Islam, A. Muhammad and S. Munir. 2017. The effects of phosphorus management on yield and yield components of wheat varieties. Int. J. Agric. Environ. Res., 3(4): 13-19.

Aslani, F. and M.R. Mehrvar. 2012. Responses of wheat genotypes as affected by different sowing dates. Asian J. Agric. Sci., 4(1): 72-74.

Awan, K.A., J. Ali and M. Akmal. 2017. Yield comparison potential wheat varieties by delay sowing as rainfed crop for Peshawar climate. Sarhad J. Agric., 33(3): 480-488. https://doi.org/10.17582/journal.sja/2017/33.3.480.488

Ayaz, K., 2016. Performance of different bread wheat varieties for yield and yield attributes under diallel combinations. Ann. Agrar. Sci., 14: 25-34. https://doi.org/10.1016/j.aasci.2016.03.001

Baloch, A.W., M. Baloch, M.J. Baloch, R.A. Kandhro, M.N. Kandhro, N. Gandahi, G.M. Baloch, I.A. Baloch, M. Ali and A.M. Baloch. 2016. Evaluation of exotic bread wheat genotypes for yield and its associated traits. Int. J. Biol. Biotech., 13(1): 107-110.

Baloch, M.S., I.T.H. Shah, M.A. Nadim, M.I. Khan and A.A. Khakwani. 2010. Effect of seeding density and planting time on growth and yield attributes of wheat. J. Anim. Plant Sci., 20(4): 239-242.

Baloch, M. J., Dunwell, J., Khakwani, A. A., Dennett, M., Jatoi, W. A., & Channa, S. A. 2012. Assessment of wheat cultivars for drought tolerance via osmotic stress imposed at early seedling growth stages. J. Agric. Res., 50(3): 299-310.

El-Sarag, E.I. and R.I.M. Ismaeil. 2015. Evaluation of some bread wheat cultivars productivity as affected by sowing dates and water stress in semi-arid region. Asian J. Crop Sci., 5(2): 167-178. https://doi.org/10.3923/ajcs.2013.167.178

Gul, H., B. Saeed, A.Z. Khan, B. Haleema, L. Parveen and N.L. Badshah. 2012. Morphological and some yield attributes in cultivars of wheat in response of varying planting dates and nitrogen application. ARPN J. Agric. Biol. Sci., 7(2): 100-109.

Jamali, L.A., S.A. Soomro, A.A. Abro, Z.A. Khan and N.H. Walhari. 2016. Effect of grain moisture content on physicoengineering properties of wheat. J. Agric. Res., 54(4): 773-785.

Khan, A.A., M.A. Alam, M.K. Alam, M.J. Alam and Z.I. Sarker. 2013b. Genotypic and phenotypic correlation and path analysis in durum wheat. Bangladesh J. Agric. Res., 38(2): 219-225. https://doi.org/10.3329/bjar.v38i2.15885

Khan, B., M. Arif, F. Munsif, M.M. Anjum, E. Wójcik-Gront, A. Khan, I. Ahmad, Y. Ren, C. Zhao, X. Liao and S. Zhang. 2022a. Optimizing sowing window for local and Chinese elite lines under changing climate. Agronomy, https://doi.org/10.3390/agronomy12092232

Kumar, P., R. Yadava, B. Gollen, S. Kumar, R.K. Verma and S. Yadav. 2011. Nutritional contents and medicinal properties of wheat: A review. Life Sci. Medic. Res., 22: 1-10.

Laghari, K.A., M.A. Sial and M.A. Arain. 2012. Effect of high temperature stress on grain yield and yield components of wheat (*Triticum aestivum* L.). Sci. Technol. Dev., 31: 83-90.

MNFS and R. 2018. Agriculture Statistics of Pakistan, Ministry of National Food Security and Research, Islamabad, Pakistan.

Mumtaz, M.Z., M. Aslam, H.M. Nasrullah, M. Akhter and B. Ali. 2015. Effect of various sowing dates on growth, yield and yield components of different wheat genotypes. Am. Eurasian J. Agric. Environ. Sci., 15(11): 2230-2234.

Mushtaq, T., S. Hussain, M.A.H.A. Bukhsh, J. Iqbal and T. Khaliq. 2011. Evaluation of two wheat genotypes performance of under drought conditions at different growth stages. Crop Environ., 2(2): 20-27.

Naveed, K., M.A. Khan, M.S. Baloch, K. Ali, M.A. Nadim, E.A. Khan, S. Shah and M. Arif. 2014. Effect of different seeding rates on yield attributes of dual-purpose wheat. Sarhad J. Agric., 30(1): 83-91.

Singh, S.K., R. Chatrath and B. Mishra. 2010. Perspective of hybrid wheat research: A review. Indian J. Agric. Sci., 80(12): 1013-1027.

Steel, R.G.D., H. Torrie and D.A. Dickey. 1997. Principles and procedures of statistics. A biometrical approach. 3rd ed. McGraw Hill, Inc. New York.

Tahir, M., A. Ali, M.A. Nadeem, A. Hussain and F. Khalid. 2009a. Effect of different sowing dates on growth and yield of wheat (*Triticum aestivum L*) varieties in district Jhang, Pakistan. Pak. J. Life Soc. Sci., 7(1): 66-69.

Tahir, S., A. Ahmad, T, Khaliq and M.J.M. Cheema. 2019b. Evaluating the impact of seed rate and sowing dates on wheat productivity in semi-arid environment. Int. J. Agric. Biol., 22(1): 57-64.

Tunio, A., H. Magsi and M.A. Solangi. 2016. Analyses of growth trends and production forecast of cash crops in Pakistan. Int. J. Agron. Agric. Res., 9(1): 158-164.

Williams, D. and A. Raza. 2015. Pakistan grain and feed annual report. Global agricultural information network, Gain Report Number: PK 1517.

Zulfiqar, F. and M. Ashfaq. 2014. Estimation of wheat yield response under different agro-climatic conditions in Punjab. Sarhad J. Agric., 30(4): 459-465.