



Abundance, distribution and diversity of weeds in wheat in Haryana

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Wheat (*Triticum aestivum* L.) crop is infested with both grassy and broad-leaf weeds. Losses caused by weeds in wheat vary from 30-50% depending upon type of weed flora, time, and intensity of weed infestation, but in extreme cases there could be complete crop failure (Malik and Singh 1995). Weed flora has been in a state of dynamism brought about by mankind for his benefits, thus paving the way for superior competitive species to gain the foothold in changed soil conditions. Species which have same ecological demands are inclined to occupy the same habitats with much rapidity. Crop type and soil properties have greatest influence on the occurrence of weed species (Streibig *et al.* 1984, Andreasen *et al.* 1991). The type of irrigation, cropping pattern, weed control measures and environmental factors have a significant influence on the intensity and infestation of weeds (Saavedra *et al.* 1990). Abundance measures the quantitative significance of a species in its habitat. It describes the success of weed in terms of numbers. Density and frequency are the two simplest and most popular methods of measuring abundance. Whereas, the distribution of weed species denotes its natural geographic range. It is the description of where the species naturally occurs or where it has been recorded. Weed flora distribution is a dynamic phenomenon because it changes over time as the result of climatic, anthropogenic or ecological factors. Changes in a weed distribution can provide critical information regarding the weed species expansion or contraction, predictability of occurrence, effectiveness of control measures, habitat preferences and dispersal mechanisms. In contrast, weed diversity can be explored at several different scales from number of species per unit area to genetic diversity. It represents the number of species present in an area and specifies the abundance of each species in a community. Therefore, knowledge of weed species associated with crops in a region is pivotal and necessary to plan and execute a sound and economical weed management schedule depending upon various factors affecting weed

distribution in different areas. The present survey was planned to study the abundance, distribution and diversity of weed flora in wheat crop in 14 wheat growing districts of Haryana state.

To study the floristic composition of weeds in wheat in Haryana, 292 fields were surveyed in Ambala, Karnal, Kaithal, Jind, Sonapat, Rohtak, Faridabad, Rewari, Palwal, Bhiwani, Mahendragarh, Sirsa, Fatehbad and Hisar districts of state during January - March, 2012 and 2013. This period of survey depicts most appropriate representation of majority of weed species and the cumulative effects of all agronomic practices, soil type, fertilizer and irrigation application and weed control measures adopted during initial crop growth stages. The road map of Haryana state was followed and routes were planned to establish sampling localities as equidistantly as possible (about 10 kms) avoiding inhabited areas. Four observations on density of individual weeds were recorded per field at one spot by using quadrat of 0.5 x 0.5 m, 100 meters deep inside the fields. Pooled average values of observations of relative density (RD), relative frequency (RF) and importance value index (IVI) of individual weeds were thus calculated as per method suggested by Misra (1968) and Raju (1977).

North-eastern Haryana region is characterized with abundant irrigation facilities and fertile alluvial soils. Wheat crop is mainly grown after rice and sugarcane ratoon in this region. In south-western districts, wheat is grown after cotton, pearl millet and rice. Soils are sandy loam to clay loam in texture and crop is raised with both tube well and canal water supply. In Bhiwani and Mahendragarh districts, soils are loamy sand in texture with sprinkler irrigation facility.

Weed flora density and diversity

Weed flora composition significantly diverged among districts due to different cropping systems, soil types, rainfall amount, fertility status, irrigation facilities, quality of underground water and weed control measures in addition to other agronomic practices.

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Overall twenty one weed species were present in the surveyed wheat fields. Weed flora was more diverse in south-western districts as compared to north-eastern districts of Haryana. Out of 21 weed species, 4 grassy and 17 broad-leaf weeds were found to be highly associated with wheat crop (Table 1 and 2). Grassy weed *Phalaris minor* with IVI values of 43.2-97.7 was most dominant weed in all the districts surveyed except Bhiwani, Mahendragarh and Rewari. The maximum RD (78.3%) and IVI (97.7) of *P. minor* was found in Karnal district whereas minimum RD (2.4%) and IVI (7.4) were observed in Rewari and Mahendragarh districts, respectively. *Phalaris minor* dominance in rice-wheat crop rotation is largely due to its ecological requirements and development of resistance to herbicides of various mechanisms of actions (MoAs).

Another grassy weed, *Avena ludoviciana* with a RD of 0.5–21.7% and IVI values of 1.5 - 43.4% also showed its presence in south-western districts i.e. Hisar, Fatehabad, Rewari, Mahendragarh and Palwal whereas this weed was conspicuous by its absence in north-eastern districts of Haryana, viz. Ambala, Karnal, Jind, Kaithal, Sonapat and Rohtak due to unfavorable ecological conditions for its establishment in predominant rice-wheat crop rotation (Figure 1). Grassy weeds of moist soils *Polypogon monspiliensis* and *Poa annua* showed their presence only in north-eastern districts. Greater

occurrence and higher relative density of grassy weeds in north-eastern region may be on account of relatively high moisture and use of more fertilizers in rice-wheat sequence.

In north-eastern districts, among broad-leaf weeds *Chenopodium album*, *Rumex dentatus*, *Coronopus didymus*, *Anagallis arvensis* and *Medicago denticulata* were found to be highly aggressive and dominating whereas in south-western districts Bhiwani, Rewari, Hisar, Fatehabad, Sirsa, Faridabad and Mahendragarh in addition to *C. album* and *C. murale*, *T. polycerata*, *Melilotus indica*, *Rumex spinosus*, *Fumaria parviflora* and *Asphodelus tenuifolius* were dominating broad-leaf weeds. Abundance of these weeds in south-western Haryana may be due to light soils of low fertility, less use of herbicides and presence of underground brackish water in some part of these areas.

Chenopodium album with a relative density of 4.4 to 30.8% and IVI of 18.1 – 57.2% was the most dominant weed in all districts except Faridabad where *C. murale* with IVI value of 27.3% was found to be most aggressive weed. Slightly saline underground waters used for irrigation in south-western districts may be the reason for more prevalence of *C. murale* in these areas as this weed flourishes only under saline-sodic waters. The maximum IVI of *C. album* was recorded in Mahendragarh (57.2) followed by

Table 1. Weed flora of wheat in Ambala, Karnal, Kaithal and Jind districts of Haryana

Weed species	Family	Ambala			Karnal			Kaithal			Jind		
		RD (%)	RF (%)	IVI	RD (%)	RF (%)	IVI	RD (%)	RF (%)	IVI	RD (%)	RF (%)	IVI
Grassy													
<i>Phalaris minor</i>	Gramineae	56.8	20.3	77.1	78.3	19.4	97.7	60.9	13.8	74.7	67.8	19.7	87.5
<i>Avena ludoviciana</i>	Gramineae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Poa annua</i>	Gramineae	2.0	5.7	7.7	1.1	5.1	6.2	0.5	1.3	1.8	2.0	4.5	6.5
<i>Polypogon monspiliensis</i>	Gramineae	2.7	7.6	10.3	2.9	11.6	14.5	4.7	8.4	13.1	4.4	13.4	17.8
Broad-leaf													
<i>Chenopodium album</i>	Chenopodiaceae	11.0	15.2	26.2	4.4	14.1	18.5	8.1	13.8	21.9	11.5	17.3	28.8
<i>Chenopodium murale</i>	Chenopodiaceae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Rumex dentatus</i>	Polypogonaceae	7.8	15.2	23.0	2.3	10.3	12.6	4.7	9.8	14.5	6.3	12.6	18.9
<i>Rumex spinosus</i>	Polypogonaceae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Coronopus didymus</i>	Cruciferae	5.4	10.1	15.5	3.8	12.2	16.0	7.1	16.7	23.8	3.1	11.0	14.1
<i>Anagallis arvensis</i>	Primulaceae	3.6	5.1	8.7	4.1	14.2	18.3	5.5	12.5	18.0	1.1	4.7	5.8
<i>Medicago denticulata</i>	Leguminosae	4.2	8.8	13.0	2.0	7.7	9.7	4.7	8.4	13.1	2.4	11.0	13.4
<i>Melilotus indica</i>	Leguminosae	3.3	6.4	9.7	0.1	1.2	1.3	1.2	4.2	5.4	0.1	0.7	0.8
<i>Malva parviflora</i>	Malvaceae	2.7	5.1	7.8	0.7	3.8	4.5	1.7	4.1	5.8	0.0	0.0	0.0
<i>Convolvulus arvensis</i>	Convolvulaceae	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.4	1.6	0.2	2.7	2.9
<i>Cirsium arvense</i>	Compositae	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.4	1.6	0.0	0.0	0.0
<i>Vicia sativa</i>	Leguminosae	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.3	1.8	0.0	0.0	0.0
<i>Trigonella polycerata</i>	Leguminosae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Asphodelus tenuifolius</i>	Liliaceae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Fumaria parviflora</i>	Fumariaceae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Pluchea lanceolata</i>	Compositae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Carthamus oxycantha</i>	Compositae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2. Weed flora of wheat in Fatehabad, Hisar, Sirsa, Sonipat and Rohtak districts of Haryana

Weed species	Fatehabad			Hisar			Sirsa			Sonipat			Rohtak		
	RD (%)	RF (%)	IVI	RD (%)	RF (%)	IVI	RD (%)	RF (%)	IVI	RD (%)	RF (%)	IVI	RD (%)	RF (%)	IVI
Grassy															
<i>Phalaris minor</i>	47.9	22.6	70.5	35.0	18.2	53.2	39.7	30.2	69.9	55.1	25.5	80.6	59.0	30.7	89.7
<i>Avena ludoviciana</i>	2.4	8.5	10.9	15.4	10.6	26.0	10.8	9.4	20.2	0.0	0.0	0.0	0.0	0.0	0.0
<i>Poa annua</i>	0.2	1.0	1.2	0.0	0.0	0.0	0.5	3.4	3.9	1.2	1.4	2.6	3.2	3.2	6.4
<i>Polypogon monspiliensis</i>	1.9	9.6	11.5	0.0	0.0	0.0	0.5	7.3	7.8	5.6	8.5	14.1	7.6	12.7	20.3
Broa-leaf															
<i>Chenopodium album</i>	14.0	5.4	19.4	25.3	16.6	41.9	15.2	7.4	22.6	12.1	26.0	38.1	9.6	15.3	24.9
<i>Chenopodium murale</i>	0.7	2.1	2.8	5.3	5.7	11.0	2.7	2.1	4.8	0.0	0.0	0.0	0.0	0.0	0.0
<i>Rumex dentatus</i>	4.5	7.5	12.0	2.8	5.5	8.3	7.4	7.5	14.9	5.2	9.7	14.9	6.0	14.0	20.0
<i>Rumex spinosus</i>	9.2	5.4	14.6	1.0	3.2	4.2	8.5	5.4	13.9	0.0	0.0	0.0	0.0	0.0	0.0
<i>Coronopus didymus</i>	6.5	15.0	21.5	1.5	5.5	7.0	3.6	3.2	6.8	5.2	9.2	14.4	3.3	6.8	10.1
<i>Anagallis arvensis</i>	1.9	5.4	7.3	0.9	4.0	4.9	0.5	5.4	5.9	5.6	8.2	13.8	3.3	3.7	7.0
<i>Medicago denticulata</i>	5.2	9.6	14.8	0.8	4.8	5.6	3.6	3.6	7.2	3.5	2.6	6.1	4.2	6.0	10.2
<i>Melilotus indica</i>	1.1	5.4	6.5	2.3	7.1	9.4	3.1	3.5	6.6	3.2	4.2	7.4	1.2	1.6	2.8
<i>Malva parviflora</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.0	4.0	0.6	1.2	1.8
<i>Convolvulus arvensis</i>	1.9	4.3	6.2	5.7	7.1	12.8	1.6	4.3	5.9	0.3	1.4	1.7	0.3	3.3	3.6
<i>Cirsium arvense</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Vicia sativa</i>	0.0	0.0	0.0	1.5	3.1	4.6	0.0	0.0	0.0	1.2	1.4	2.6	1.2	1.0	2.2
<i>Trigonella polycerata</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Asphodelus tenuifolius</i>	0.0	0.0	0.0	3.2	7.4	10.6	2.5	7.4	9.9	0.0	0.0	0.0	0.0	0.0	0.0
<i>Fumaria parviflora</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Pluchea lanceolata</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Carthamus oxycantha</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 3. Weed flora of wheat in Faridabad, Rewari, Palwal, Mahendragarh and Bhiwani districts of Haryana

Weed species	Faridabad			Rewari			Palwal			M. Garh			Bhiwani		
	RD (%)	RF (%)	IVI	RD (%)	RF (%)	IVI	RD (%)	RF (%)	IVI	RD (%)	RF (%)	IVI	RD (%)	RF (%)	IVI
Grassy															
<i>Phalaris minor</i>	29.4	13.8	43.2	2.4	6.4	8.8	52.7	29.7	82.4	3.2	4.2	7.4	8.4	7.4	15.8
<i>Avena ludoviciana</i>	16.7	12.7	29.4	21.7	21.7	43.4	2.1	0.6	2.7	7.2	14.6	21.8	0.5	1.0	1.5
<i>Poa annua</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Polypogon monspiliensis</i>	1.2	8.4	9.6	0.0	0.0	0.0	3.5	2.3	5.8	0.0	0.0	0.0	0.0	0.0	0.0
Broad-leaf															
<i>Chenopodium album</i>	13.0	5.1	18.1	23.4	24.6	48.0	10.4	16.9	27.3	30.8	26.4	57.2	29.7	27.0	56.7
<i>Chenopodium murale</i>	14.1	13.2	27.3	14.9	21.8	36.7	1.5	1.6	3.1	22.7	14.3	37.0	20.7	12.0	32.7
<i>Rumex dentatus</i>	7.9	9.7	17.6	0.0	0.0	0.0	12.5	20.5	33.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Rumex spinosus</i>	0.7	2.5	3.2	8.4	3.8	12.2	0.0	0.0	0.0	4.2	3.4	7.6	2.9	3.0	5.9
<i>Coronopus didymus</i>	2.5	5.7	8.2	0.0	0.0	0.0	2.1	5.0	7.1	0.0	0.0	0.0	0.0	0.0	0.0
<i>Anagallis arvensis</i>	0.5	8.5	9.0	0.0	0.0	0.0	3.1	4.7	7.8	0.0	0.0	0.0	0.0	0.0	0.0
<i>Medicago denticulata</i>	2.3	8.3	10.6	0.0	0.0	0.0	4.5	9.0	13.5	0.0	0.0	0.0	0.0	0.0	0.0
<i>Melilotus indica</i>	7.2	4.2	11.4	6.5	3.1	9.6	0.1	1.5	1.6	3.6	3.4	7.0	1.6	3.0	4.6
<i>Malva parviflora</i>	1.7	4.1	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Convolvulus arvensis</i>	0.2	1.4	1.6	2.5	3.1	5.6	0.2	2.4	2.6	1.3	2.4	3.7	0.7	2.0	2.7
<i>Cirsium arvense</i>	0.2	1.4	1.6	0.0	0.0	0.0	3.2	0.5	3.7	0.0	0.0	0.0	0.0	0.0	0.0
<i>Vicia sativa</i>	2.5	1.3	3.8	0.5	3.1	3.6	1.4	0.5	1.9	2.6	0.0	2.6	0.6	0.0	0.6
<i>Trigonella polycerata</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.4	12.4	23.8	9.7	11.0	20.7
<i>Asphodelus tenuifolius</i>	0.0	0.0	0.0	5.5	3.5	9.0	0.0	0.0	0.0	7.6	15.7	23.3	19.6	33.0	52.6
<i>Fumaria parviflora</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.4	3.4	8.8	3.4	3.0	6.4
<i>Pluchea lanceolata</i>	0.0	0.0	0.0	11.4	3.6	15.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Carthamus oxycantha</i>	0.0	0.0	0.0	2.8	5.5	8.3	2.4	2.5	4.9	0.0	0.0	0.0	0.0	0.0	0.0

Bhiwani (56.7), Rewari (48.0) and Hisar (41.9). Robust dicotyledonous weed *Malva parviflora* habitant of heavy textured soils and zero till planted wheat was found only in Ambala, Karnal,

Kurukshetra, Rohtak, Sonapat and Fardiabad districts. *Medicago denticulata* broad-leaf weed of *leguminosae* family was present in all rice growing districts whereas weed of same family *Trigonella*

polycerata was found in light textured soils of south-western districts viz. Singh *et al.* (1995) also reported the occurrence of this weed in light textured soil. *Phalaris minor* was the single most dominating weed under rice-wheat cropping system, whereas *Phalaris minor*, *Chenopodium album* and *Avena ludoviciana* had higher relative densities under cotton-wheat cropping system (Figure 1).

The survey indicates that distribution and diversity of weed species could be directly correlated to the soil type, rainfall, irrigation facilities, quality of underground water, fertility status and cropping patterns as varied in different districts of Haryana. Therefore, the present survey could be of much practical value in formulating local management

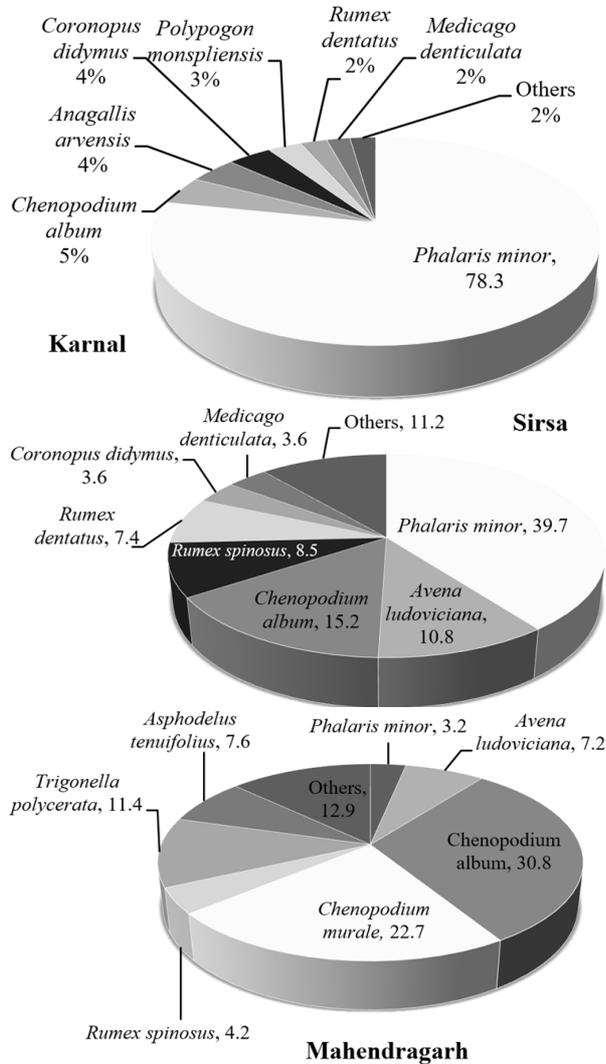


Figure 1. Relative density (%) of most dominated weed species in wheat under rice-wheat (Karnal), cotton-wheat (Sirsa) and pearlmillet-wheat (Mahendragarh) cropping systems

strategies depending upon types of weed species, their abundance and distribution to sustain wheat productivity.

SUMMARY

To study the floristic composition of weeds in wheat, 292 fields were surveyed in fourteen wheat growing districts of Haryana state during January–March 2012 and 2013. In all, 21 weed species (4 grassy and 17 broad-leaf) were found to infest wheat fields in Haryana. Grassy weed *Phalaris minor* was most dominant weed with IVI values of 43.2-97.7 in all the surveyed districts except Bhiwani, Mahendragarh and Rewari. Another grassy weed, *Avena ludoviciana* showed its presence with a RD of 0.5-21.7% and IVI values of 1.5-43.4% in south-western districts of Haryana. Grassy weeds of moist soils *Polypogon monspiliensis* and *Poa annua* showed their presence only in north-eastern districts. *Chenopodium album* and *Chenopodium murale*, *Trigonella polycerata*, *Melilotus indica*, *Rumex spinosus*, *Fumaria parviflora* and *Asphodelus tenuifolius* were dominating broad-leaf weeds in south-western districts. Robust dicotyledonous weed *Malva parviflora*, adherent to heavy textured soils and zero till planted wheat, was mainly confined in Ambala, Karnal, Kurukshetra, Rohtak, Sonapat and Fardiabad districts. *Convolvulus arvensis*- a broad-leaf climber in all districts except Ambala and Karnal.

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