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# Phyto-sociological attributes of weed flora in brown mustard growing areas of temperate Kashmir valley

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**ABSTRACT**

A study on weed flora was conducted to evaluate the weed species distribution across different brown mustard (*Brassica rapa* var. brown *sarson*) growing areas of Kashmir valley during *Rabi* (2016-17 and 2017-18). The occurrence of weed species was assessed on the basis of different phyto-sociological attributes, *viz.* weed species density, relative density, relative frequency and importance value index. These were computed from the data collected during the month of March. In all twenty weed species were identified of which sixteen were broad-leaved. The crop was highly infested with the weed species of Poaceae family with the dominance of *Poa annua* (IVI of 84.9, 50.6 and 44.1 in Pulwama, Anantnag and Kulgam, respectively). Among the broad-leaved weeds, *Veronica persica* was the most dominant species found in Budgam with the abundance value of 17.25 and IVI of 34.5. Budgam had the highest weed species distribution with Simpson's diversity index (D) of 0.120123.

## INTRODUCTION

Rapeseed-mustard occupies a pivotal position among oilseed crops in India. Belonging to the family brassicaceae, this group of oilseeds is an important source of edible oil, and ranks third after soybean and oil palm in terms of area and production in the world (Adnan *et al.* 2013). India has a growing demand for vegetable oil and fats to feed its ever increasing population with an estimated demand of 58 million tonnes (mt) by 2020 (Mittal 2008). In Jammu & Kashmir, rapeseed-mustard occupies an area of 0.05 million hectares with the production of 0.03 mt and productivity of 0.59 t/ha (Anonymous 2016). Brown mustard (*Brassica rapa* var. brown *sarson*) is an important and only winter *(Rabi)* season oilseed crop which fits well in rice-based cropping system of Kashmir. Since the crop is sown in the second week of October, the temperature after sowing dips low, enforcing the rosette formation in the crop, and subsequent crop growth gets slowed down, making a congenial environment for the weeds. Being a long duration crop (about 7-8 months), weeds severely compete with the crop for different resources, causing a significant decline in crop productivity to the extent of 10-70% depending upon type, intensity and duration of competition(Bijarnia *et al.* 2017). As the distribution and infestation of each weed is different, the extent of yield reduction will mainly depend on the type of the weed, its intensity and the stage of crop growth. In order to devise a cost-effective weed control strategy in brown mustard, it is worthy to know the floristic composition of weeds and their intensity and frequency. Thus, an attempt was made to investigate the weed flora and species diversity across different districts of Kashmir valley.

## MATERIALS AND METHODS

The study was carried out in south (Anantnag, Kulgam and Pulwama) and central districts (Budgam) of Kashmir valley (**Figure 1**), located in the north of Himalaya at 73$^{R"}$ 45$^{'}$-75$^{R"}$ 35' E longitude, 32$^{R"}$ 25$^{'}$-34$^{R"}$ 55' N latitude and altitude of 1450-7,000 m above mean sea level. The sites had a varied topography with temperate climate, having moderate summer temperature of up to 37 $^{R"}$C and harsh winter with mercury dipping down to -10 $^{R"}$C. The surveys were conducted in brown *sarson* growing areas in the month of March during *Rabi* season of (2016-17 and 2017-18) under ICAR-AICRP-R&M, when the crop resumed growth after experiencing harsh winters

with the temperatures dipping as low as -5.8 fÂC (Singh *et al.* 2007). Weed survey was carried out using the quantitative survey method of Thomas (1985). The observations were recorded in the cropped field from each district at three locations. Quadrates of 50 × 50 cm were thrown randomly within each plot at three spots. The weeds within each quadrant were uprooted, sorted into species, identified, counted and recorded. Data were subjected to important quantitative analyses such as density, frequency, relative frequency, relative density, importance value index (IVI) and abundance using the following formulae given by Curtis and McIntosh (1950). IVI was used to determine the overall importance of each species in the community structure. Simpson's diversity index (D), Simpson's index of diversity (1-D), and Simpson's reciprocal index (1/D) were also computed.

$$\text{Density} = \frac{\text{Number of species}}{\text{Area of quadrant}}$$

$$\text{Relative frequency} = \frac{\text{Frequency of species}}{\text{Total frequencies of all the species}} \times 100$$

$$\text{Relative density} = \frac{\text{Density of species}}{\text{Total density of all the species}} \times 100$$

$$\text{Importance value index (IVI)} = \text{Relative Frequency} + \text{Relative Density}$$

$$\text{Abundance} = \frac{\text{Relative Frequency} + \text{Relative Density}}{2}$$

$$Simpson\ diversity\ index\ (D) = \frac{\sum n\,(n-1)}{N(N-1)}$$

Where, n = the total number of weeds of particular species and N = the total number of weed of all species.

Where, D = Simson diversity index

$$\text{Simpson's reciprocal index} = \frac{1}{D}$$

$$\text{Simpson's index of diversity} = 1 - D$$

## RESULTS AND DISCUSSION

Weed survey in brown mustard growing areas of different districts (**Figure 1**) revealed a total of 20 weed species belonging to fourteen families (**Table 1**). Poaceae represented maximum number of species (4) and proportional abundance of 0.2 and was followed by Asteraceae, Brassicaceae and Caryophyllaceae with two species each and proportional abundance of 0.01 (**Table 2**). The rest of the families contained single species, each representing proportional contribution of 0.05 of the total relative abundance. Further, it was observed that brown mustard fields were highly infested by the weeds of Poaceae family with proportionate share of 20%, followed by Caryophyllaceae and Brassicaceae (**Figure 2**). With regard to morphology, the weed infestation was dominated by sixteen broad-leaved weed (BLW) species (80.0%), three grass species (Poacae, 15.0%) and one sedge species (Cyperaceae, 5.0%). The dominance of BLW species could be attributed to higher colonizing power owing to their higher seed production potentials and efficient means of seed dispersal (Oluwatobi and Olorunmaiye 2014). *Arenaria serpyllifolia*, *Fumaria parviflora*, *Poa annua*, *Capsella bursa-pastoris* and *Stellaria media* were common in all the four districts, which could be attributed to their acclimatizing ability over a wide range of ecological conditions. Similar results were observed by Karaye *et al.* (2007) who reported that weed species had a wide range of adaptability in growth habitat. Greater diversity in weed species was recorded in Anantnag, Kulgam and Budgam as evidenced from more number of species (**Table 1**). Variability was observed in weed diversity across the locations studied. *Poa annua*, the most prolific weed in brown *sarson*, recorded the highest IVI value of 84.9, 50.6, 44.1 in Pulwama, Anantnag and Kulgam, respectively, whereas *Veronica persica* in Budgam preceded (34.5) by *Poa annua* (31.3). This was in conformity with the earlier report of Singh *et al.* (2007), who reported the highest IVI of 51.0 for *Poa*


**Figure 1. Districts surveyed under the investigation**

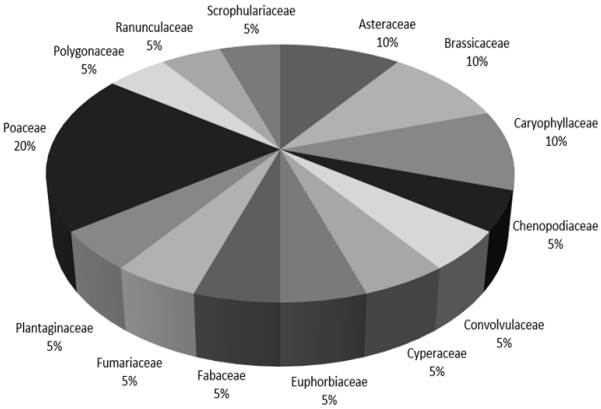


**Figure 2. Proportion of weed infestation by different weed families**

**Table 1. Weed flora of brown *sarson* and its phyto-sociological attributes in south and central Kashmir (pooled data of 2 years)**

| Weed species | Anantnag | | | | Kulgam | | | | Budgam | | | | Pulwama | | | | Family | Group | Cotyledon |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Weed density/m2 | Relative frequency(%) | Relative density(%) | IVI | Weed density/m2 | Relative frequency(%) | Relative density(%) | IVI | Weed density/m2 | Relative frequency(%) | Relative density(%) | IVI | Weed density/m2 | Relative frequency(%) | Relative density(%) | IVI | | | |
| *Arenaria serpyllifolia* | 14.3 | 8.5 | 9.9 | 18.4 | 12.3 | 9.0 | 10.9 | 19.9 | 12.0 | 3.0 | 13.3 | 16.3 | 60.0 | 24.4 | 21.9 | 46.4 | Caryophyllaceae | BL | D |
| *Capsella bursa-pastoris* | 1.7 | 7.6 | 1.1 | 8.7 | 2.3 | 8.0 | 2.0 | 10.0 | 3.0 | 6.0 | 3.3 | 9.4 | 64.0 | 5.8 | 23.3 | 29.2 | Brassicaceae | BL | D |
| *Chenopodium album* | 2.4 | 7.6 | 1.7 | 9.2 | 1.7 | 8.0 | 1.5 | 9.6 | - | - | - | - | - | - | - | - | Chenopodiaceae | BL | D |
| *Convolvulus arevensis* | 1.9 | 7.6 | 1.2 | 8.9 | 2.4 | 9.0 | 2.2 | 11.1 | - | - | - | - | - | - | - | - | Convolvulaceae | BL | D |
| *Conyza canadensis* | - | - | - | - | - | - | - | - | 3.33 | 9.1 | 3.7 | 12.8 | - | - | - | - | Asteraceae | BL | D |
| *Coronopus didymus* | - | - | - | - | - | - | - | - | 15.0 | 9.1 | 16.7 | 25.7 | - | - | - | - | Brassicaceae | BL | D |
| *Cynodon dactylon* | 3.9 | 8.5 | 2.7 | 11.2 | 2.8 | 9.0 | 2.2 | 11.5 | 3.0 | 6.0 | 3.3 | 9.4 | - | - | - | - | Poaceae | G | M |
| *Cyperus rotundus* | - | - | - | - | - | - | - | - | 16.0 | 3.0 | 17.8 | 20.8 | - | - | - | - | Cyeprceae | S | M |
| *Euphorbia hispida* | 2.5 | 7.6 | 1.8 | 9.4 | 3.1 | 8.1 | 2.7 | 10.9 | - | - | - | - | - | - | - | - | Euphorbiaceae | BL | D |
| *Fumaria parviflora* | - | - | - | - | - | - | - | - | 3.6 | 15.1 | 4.0 | 19.1 | 12.5 | 24.4 | 4.6 | 28.9 | Fumariaceae | BL | D |
| *Matricaria chamomilla* | 4.1 | 7.6 | 2.9 | 10.5 | 3.2 | 9.0 | 2.9 | 11.8 | - | - | - | - | - | - | - | - | Asteraceae | BL | D |
| *Plantago lanceolata* | 2.3 | 7.2 | 2.0 | 9.2 | 2.1 | 7.6 | 1.4 | 9.1 | - | - | - | - | - | - | - | - | Plantaginaceae | BL | D |
| *Phalaris minor* | 2.7 | 9.0 | 2.4 | 11.3 | 1.7 | 6.8 | 1.2 | 7.9 | - | - | - | - | - | - | - | - | Poaeceae | G | M |
| *Poa annua* | 46.8 | 9.0 | 41.7 | 50.6 | 51.7 | 8.4 | 35.6 | 44.1 | 12.0 | 18.1 | 13.3 | 31.3 | 132.6 | 36.6 | 48.4 | 84.9 | Poaeceae | G | M |
| *Polygonum hydropiper* | 12.2 | 9.0 | 10.9 | 19.9 | 14.8 | 8.4 | 10.2 | 18.6 | - | - | - | - | - | - | - | - | Polygonaceae | BL | D |
| *Ranunculus arvensis* | 22.6 | 8.4 | 20.1 | 28.4 | 30.8 | 7.9 | 21.3 | 29.1 | - | - | - | - | - | - | - | - | Ranunculaceae | BL | D |
| *Rumex acetosa* | - | - | - | - | - | - | - | - | 4.0 | 6.0 | 4.4 | 10.5 | - | - | - | - | Poaeceae | BL | D |
| *Stellaria media* | 15.5 | 8.4 | 13.8 | 22.1 | 14.2 | 7.9 | 9.8 | 17.7 | 3.5 | 6.0 | 3.9 | 9.9 | 2.0 | 5.8 | 0.7 | 6.6 | Caryophyyllaceae | BL | D |
| *Veronica persica* | - | - | - | - | - | - | - | - | 14.66 | 18.2 | 16.3 | 34.5 | - | - | - | - | Scrophulariaceae | BL | D |
| *Vicia sativa* | - | - | - | - | - | - | - | - | - | - | - | - | 3.0 | 24.4 | 1.1 | 25.5 | Fabaceae | BL | D |

*Broad-leaved = BL *Sedge= S *Grass =G

**Table 2. Proportional contribution to relative abundance for fourteen taxonomic families (pooled data of 2 years)**

| Taxonomic family | No. of species | Proportion of abundance |
|---|---|---|
| Asteraceae | 2 | 0.10 |
| Brassicaceae | 2 | 0.10 |
| Caryophyllaceae | 2 | 0.10 |
| Chenopodiaceae | 1 | 0.05 |
| Convolvulaceae | 1 | 0.05 |
| Cyperaceae | 1 | 0.05 |
| Euphorbiaceae | 1 | 0.05 |
| Fabaceae | 1 | 0.05 |
| Fumariaceae | 1 | 0.05 |
| Plantaginaceae | 1 | 0.05 |
| Poaceae | 4 | 0.20 |
| Polygonaceae | 1 | 0.05 |
| Ranunculaceae | 1 | 0.05 |
| Scrophulariaceae | 1 | 0.05 |
| Total | 20 | 0.99 |

*annua* in brown mustard grown across different altitudes in Kashmir. Similarly, *Poa annua* recorded the highest relative frequency and relative density at all the locations (**Table 1**).

Higher number of weed species were recorded in Anantnag and Kulgam followed by Budgam whilst it was the least in Pulwama. (**Table 1**). The possible reason might be the type of crop rotation prevalent in the study sites as in Pulwama the farmers were observed to follow the sequences of rice-brown *sarson* and rice-oats in comparison to the other districts having the only crop sequence of rice-brown mustard. Inclusion of oats in place of brown *sarson* in alternate years might have smothered the current weed species over the years and disturbed the weed seed bank, resulting in less number of weed species in brown mustard in comparison to other districts.

The study further revealed that the family Poaceae represented the highest number of species, with higher abundance of *Poa annua* in Anantnag and Kulgam followed by that of *Ranunculus arvensis*. However, it was followed by *Arenaria serpyllifolia* in Pulwama. At Budgam, *Veronica persica* represented higher dominance value, and was closely followed by *Poa annua* (**Figure 3**). This variation in the dominance of *Poa annua* and *Veronica persica* in south and central districts of Kasmir valley might be attributed to variation in soil fertility and soil texture as *Poa annua* was found to dominate in the areas of fertile soil with high organic matter and *Veronica persica* in heavy textured soils (Vahdati *et al.* 2017).

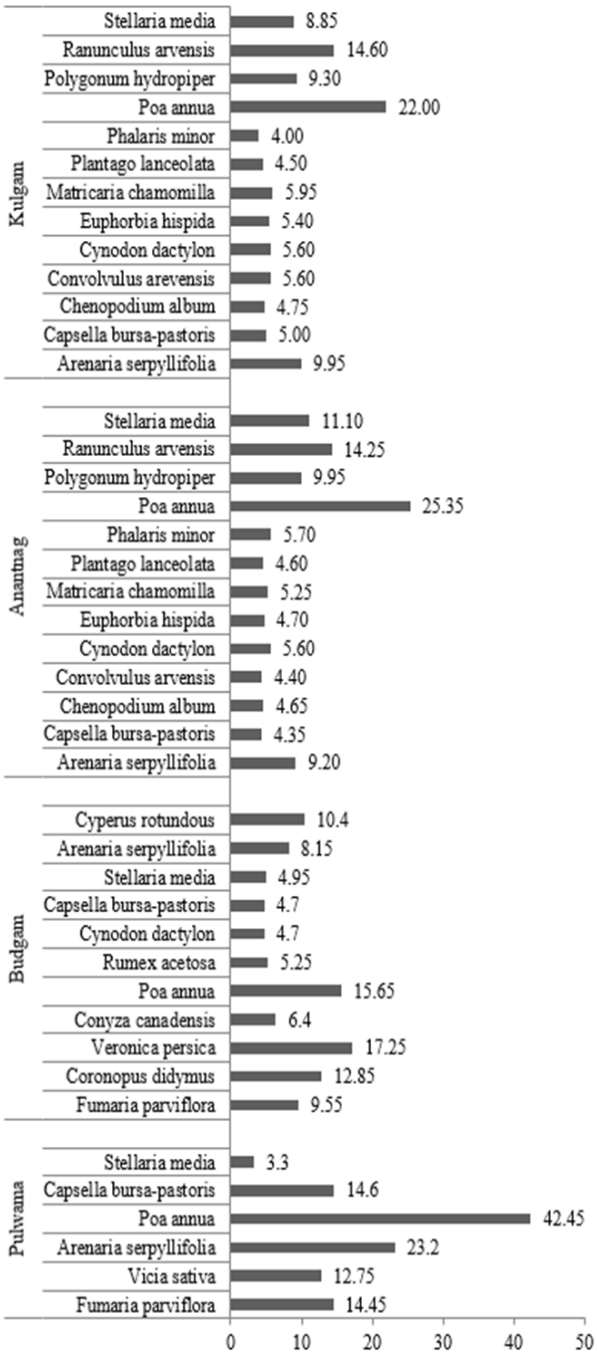


**Figure 3. Abundance of weed species in brown mustard fields of south and central districts of Kashmir**

The highest distribution of weed species was recorded from Budgam district as reflected by lower Simpson's diversity index (D = 0.120123), higher Simpson's index of diversity (0.879877) and Simpson's reciprocal index (8.324774). The lower the value of D or higher the values of (1–D) and (1/D), the greater is the diversity (**Table 3**). The decrease in weed diversity in brown mustard fields of Pulwama was due to less number of weed species observed (**Table 1**).

**Table 3. Weed species diversity in different districts of Kashmir valley**

| Location | Simpson's diversity index | Simpson's index of diversity | Simpson's reciprocal index |
|---|---|---|---|
| Pulwama | 0.336295 | 0.663705 | 2.973583 |
| Budgam | 0.120123 | 0.879877 | 8.324774 |
| Anantnag | 0.183963 | 0.816037 | 5.435861 |
| Kulgam | 0.201595 | 0.798405 | 4.960447 |

The study demonstrated that weed infestation in brown *sarson* fields of Kashmir valley was highly dominated by Poaceae family, with *Poa annua* as the most dominant weed.

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