



Endozoochorous dissemination of *Rumex dentatus* and its impact on wheat productivity

Pijush Kanti Mukherjee*

ICAR-Indian Veterinary Research Institute, Izatnagar, Bareilly, Uttar Pradesh 243 122, India

*ICAR-Directorate of Weed Research, Maharajpur, Jabalpur, Madhya Pradesh 482 004, India

*Email: pkm_agronomy@yahoo.co.in

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ABSTRACT

The effectiveness of endozoochory and germination success of the weeds after passage through the animal gut are the important traits for dissemination and invasion of weeds. With this view, experiments were conducted during the Rabi season of 2017-18 and 2018-19 at ICAR-Indian Veterinary Research Institute (IVRI), Izatnagar Campus with the objective to assess the effect of endozoochorous dissemination of weed (*Rumex dentatus*) on late sown wheat productivity (Variety HD 3059) while using cattle shed water for irrigation. The results revealed that late harvesting of the berseem led to the development of *R. dentatus* up to seeding stage. Berseem green fodder contaminated with seeds of *R. dentatus* was fed to the cattle and buffaloes. Application of carfentrazone at 25 days after sowing (DAS) reduced the population of existing broad-leaved weeds, however, use of cattle shed water for irrigation increased the population of *R. dentatus* from 35 DAS up to 17% at 50 DAS, 134% at 65 DAS and 186% at 80 DAS. Whereas, the adjacent plot irrigated with normal ground water, recorded the declining trend of *R. dentatus* population from 35 DAS i.e. up to 15, 32 and 50% reduction at 50, 65 and 80 DAS, respectively. Large infestation of *R. dentatus* due to use of cattle shed water contaminated with seeds of *R. dentatus* reduced wheat productivity up to 44% (2.14 t/ha) as compared to the grain yield 3.82 t/ha obtained from the plot irrigated with normal ground water. During second year, the entire field was irrigated with normal ground water and similarly carfentrazone was used at 25 DAS. These measures reduced the population of *R. dentatus* and weed showed declining trend up to 30, 71 and 79% reduction at 50, 65 and 80 DAS from 35 DAS. These results confirmed that *R. dentatus* has the endozoochorous mechanism of its dissemination and use of cattle shed water for irrigation may not be recommended if the berseem fodder is infested with seeds of *R. dentatus*.

INTRODUCTION

Since many weeds cannot rely only on soil seed bank, germination success through the endozoochorous seed dispersal has significant role on their survival and persistent nature into several ecosystems. The effectiveness of endozoochory as well as germination success of weeds after passage through animal gut is dependent on amount of seeds ingested, animal type and livestock digestive system (Fazelian *et al.* 2014). This can happen either deliberately due to high palatability or accidentally when an herbivore consumes seeds along with palatable leaves (Pakeman *et al.* 2002). Germination of weeds may be enhanced by the softening of the seed coats during the digestive process, however, destruction of seeds and inhibition of germination can

also occur (Ramos *et al.* 2006). Deposition of seeds with faecal material may provide nutrients that promote seedling establishment; however, seed germination and seedling establishment could also be inhibited due to the toxicity and hydrophobic nature of dung (Ramos *et al.* 2006). There is a close relationship between endozoochorous dissemination of weeds and weed infestation in crops when dung and cattle shed water for irrigation are used to provide nutrients to the crop plants. Very scanty information is available on this aspect. Therefore, present study has been conducted to study the effect of endozoochorous dissemination of weed (*R. dentatus*) on late sown wheat productivity while using cattle shed water for irrigation. Fazelian *et al.* (2014) reported that *R. ponticus* and *R. crispus* germination

percentage in cattle dung was higher than sheep and goat treatments. Among the species, germination of *Rumex ponticus* was higher than that of *R. crispus*. The seeds of plant species *Salvia officinalis*, *Conium maculatum*, *Cynara scolymus*, *Silybum marianum* and *Plantago lanceolata*, were germinated well in cattle dung treatment.

MATERIALS AND METHODS

The field experiments were conducted during the *Rabi* season of 2017-18 and 2018-19 at ICAR-Indian Veterinary Research Institute (IVRI), Izatnagar Campus, Bareilly, UP, India with the objective to assess the effect of endozoochorous dissemination of weed (*R. dentatus*) on late-sown wheat productivity (Variety *HD 3059*) while using cattle shed water for irrigation. The experiment was comprised by irrigation with cattle shed water and normal ground water in 6,000 m² land area each grown with late-sown wheat. Wheat at the seed rate of 120 kg/ha was sown on December 26 and January 4 during 2017 and 2019, respectively with the help of ferti-seed-drill. The fertilizer dose of NPK (120-60-30 kg/ha) was applied in the form of chemical fertilizer having NPK ratio of 12:32:16 as basal through ferti-seed-drill and remaining 98 kg of N/ha was applied as urea in two equal split at crown root initiation (CRI) stage of wheat and 35 days after sowing (DAS). Irrigation was given at CRI stage, jointing stage, heading stage, booting stage and grain filling stage. The herbicide carfentrazone-ethyl was applied at 25 DAS at the rate of 25 g/ha using spray volume of 600 L water/ha with knap-sack sprayer having flood-jet nozzle.

Appraisal of weed flora have been made by following standard procedure for weed survey as followed by All India Coordinated Research Project on Weed Management (ICAR), by plotting one meter square quadrats in randomized manner. The weed flora have been surveyed at different stages of wheat

crop. Absolute and relative values of density, frequency and basal area and ultimately importance value index have been determined to screen out the dominance spectrum of the species. The calculations have been used to determine absolute density, relative density, absolute frequency, relative frequency, important value and summed dominance ration of the weeds appeared in wheat crop (Raju 1997) and the data have been expressed in the form of absolute density and absolute frequency in order to highlight population and distribution of the weeds.

RESULTS AND DISCUSSION

Weed flora in wheat crop

In general, dominance of dicot weeds (77.3%) was observed during the experimental period. Major weeds observed in the experimental field were *R. dentatus*, *Solanum nigrum* and *Amaranthus viridis* among dicot weeds and *Phalaris minor* (14.8%) in monocot weeds.

Weed flora in fodder crops

Weed flora in fodder crops revealed that *Trianthema monogyna* and *T. portulacastrum* were widely distributed during summer and rainy seasons. The weed *Celosia argentea* preferred the growing condition of fodder sorghum, whereas *Coccinia grandis* was associated with fodder maize and sorghum. Among the other weeds, grasses were widely distributed, whereas the sedges were appeared in patches. Three major broad-leaved weeds *Coronopus didymus*, *R. dentatus* and *Cichorium intybus* appeared during 1st, 2nd, 3rd and 4th cutting of berseem, respectively. The results also revealed that late harvesting of the berseem led to the development of *R. dentatus* up to the seeding stage (**Figure 1**). Berseem along with *R. dentatus* was harvested and provided to the cattle as green fodder. On an average *R. dentatus* produced 1,364 seeds/plant.

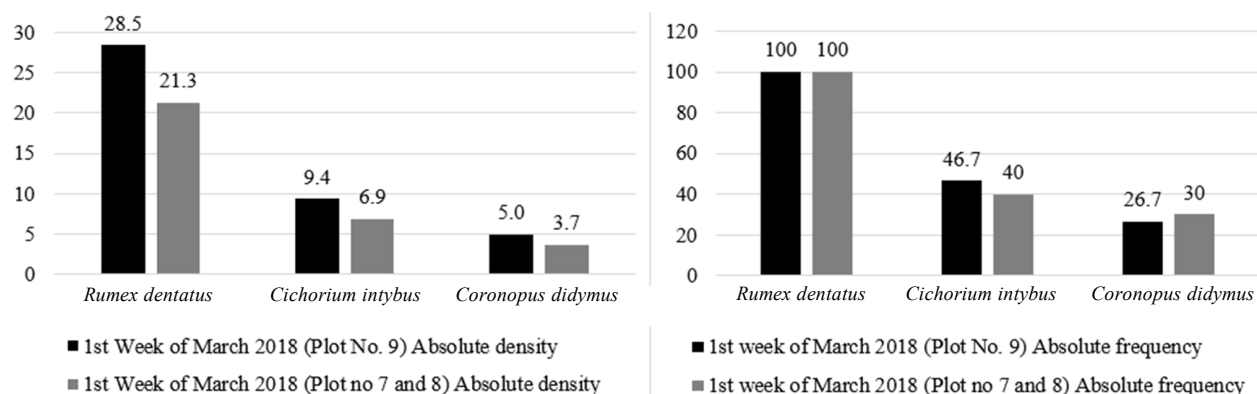


Figure 1. Absolute density (no./m²) and absolute frequency (%) of different weeds in berseem

Infestation of *Rumex dentatus* in wheat

In wheat, application of carfentrazone at 25 DAS reduced the population (no./m²) of *R. dentatus*, *Amaranthus viridis* and *Solanum nigrum* up to 63%, 70% and 64%, respectively at 35 DAS from 20 DAS. Use of cattle shed water for irrigation increased the population of *R. dentatus* from 35 DAS up to 17% at 50 DAS, 134% at 65 DAS and 186% at 80 DAS (Figure 2a and 3a). Whereas the adjacent plot irrigated with normal ground water recorded the declining trend of *R. dentatus* population from 35 DAS i.e. up to 15%, 32% and 50% at 50 DAS, 65

DAS and 80 DAS, respectively (Figure 2b and 3b). These results are in harmony with the findings of Fazelian *et al.* (2014). During the 2nd year, entire field was irrigated with normal ground water and similarly carfentrazone was used at 25 DAS. Application of herbicide reduced the population of *R. dentatus* up to 73% at 35 DAS from 20 DAS. Results revealed that population of *R. dentatus* showed declining trend up to 30, 71 and 79% reduction at 50, 65 and 80 DAS from 35 DAS (Figure 2c and 3c). Control of *R. dentatus* led to the spread of *Solanum nigrum* at the terminal phase of wheat crop.

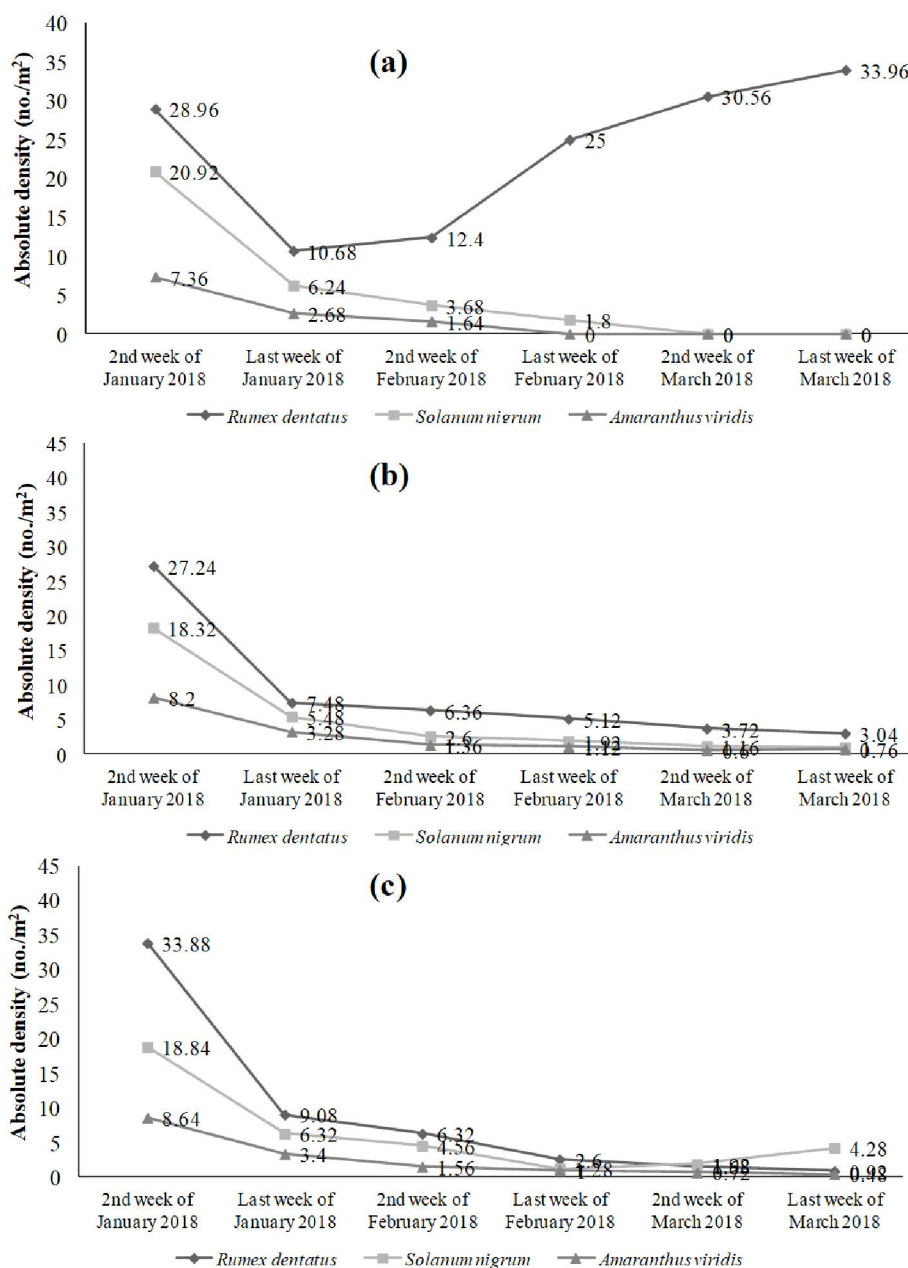


Figure 2. Absolute density (no./m²) of weeds in wheat irrigated with cattle shed water in 1st year (a), with normal ground water in 1st year (b) and with normal ground water in 2nd year (c)

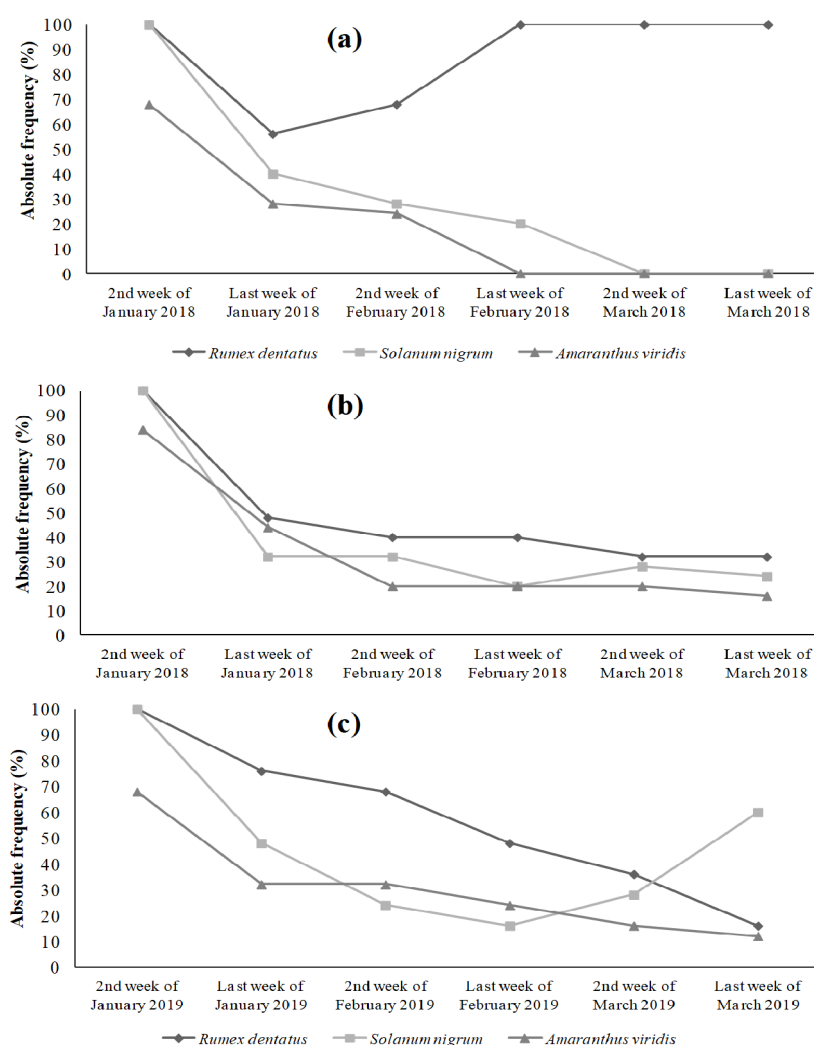


Figure 3. Absolute frequency (%) of weeds in wheat irrigated with cattle shed water in 1st year (a), with normal ground water in 1st year (b) and with normal ground water in 2nd year (c)

Effect on grain yield of wheat

Massive infestation of *R. dentatus* due to use of cattle shed water for irrigation contaminated with seeds of *R. dentatus* reduced the wheat productivity up to 44% (2.14 t/ha), whereas the plot irrigated with normal water registered the grain yield of 3.82 t/ha. During 2nd year wheat productivity was recorded to the tune of 3.92 t/ha. As the wheat (Variety *HD 3059*) was grown for seed production at KVK farm of ICAR-IVRI and also curtailed seed bank contribution of *R. dentatus*, 45 man days with the total cost of ₹ 14,500 for the area of 6000 m² irrigated with cattle shed water was invested for uprooting *R. dentatus* during 80 to 90 DAS in 1st year of experimentation. In 2nd year no such investment was required as combination of carfentrazone-ethyl and irrigation with normal ground water reduced infestation of *R. dentatus*.

It was concluded that *R. Dentatus* has the potential to disseminate through endozoochory mechanism and use of cattle shed water for irrigation may not be recommended if the berseem fodder is infested with seeds of *R. dentatus*.

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