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Study on occurrence of agrochemical poisoning in Bovines at veterinary clinics of Udgir

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Pesticide poisoning is the most common type of agrochemical poisoning observed in farm animals around the world with insecticides, rodenticides, fungicides, herbicides and molluscicides as common causal agents (Wang *et al.* 2007, McLean and Hansen 2012, Caloni *et al.* 2016). India being agrarian country with huge livestock population in hands of marginal and small-scale farmers, several incidences of pesticide and fertilizer poisoning may be happening with animals. But there is scarcity of detailed studies with respect to agrochemical poisoning in animals in India and very few case reports and experimental studies are available (Sandhu and Bal 1997, Jadhav *et al.* 2017, Jadhav *et al.* 2018, Siddiqui *et al.* 2019, Radhakrishnan 2019, Chandrashekaraiah *et al.* 2020). In foreign countries, insecticides, herbicides or weedicides, fungicides and rodenticides were commonly reported as causes of poisoning in both farm animals as well as companion animals (Caloni *et al.* 2016, Akkina and Estberg 2018, Lahmer *et al*. 2019, Chirizzi *et al.* 2020). The poisoning in domestic, farm as well as wild animals is frequently reported in several countries (McLean and Hansen 2012, Caloni *et al.* 2016, Radhakrishnan 2018, Chirizzi *et al.* 2020). Agrochemicals are being extensively used in agriculture industry may pose threat of poisoning to livestock animals causing economic losses to farmers in the form of cost of treatment and mortality in case of severe poisoning. So, there is need of detailed studies on epidemiological, clinico-pathological as well as therapeutic aspects of agrochemical poisoning in livestock animals. The present paper highlights the various epidemiological aspects of various agrochemical poisoning in cattle and buffaloes.

The present study was conducted in Veterinary Clinical Complex (VCC) of College of Veterinary and Animal Sciences, Udgir, Dist. Latur, Maharashtra over a period of 5 years from 2016-2020. The clinical cases of agrochemical poisoning admitted to clinics with detailed evidence of poisoning by animal owner were included in the study. The presentations (pesticide product bottles, plastic pouches, etc.) of pesticide responsible for poisoning if brought by owners along with ailing animal, then only cases were considered for poisoning. The cases of poisoning admitted to clinics with remains of pesticide preparations on which chemical composition was not visible or pesticides without labels were included into category of unidentified pesticides. The bovines showing signs suspicious of pesticide poisoning without any type of evidence from animal owner were not included in the study.

Epidemiology: Data in relation to month, season, species, age and sex was collected in specially designed protocol for computing the occurrence of pesticide poisoning in the study area. Detailed history was recorded with respect to nature of exposure to pesticide in affected animals. Seasons were categorized as monsoon (June-September), post-monsoon (October-November), winter (December-February) and summer (March-May). Age groups were categorized as 0-2 years, >2-4 years, >4-6 years and > 6 years.

Pesticides are chemical compounds which are used to kill pests including insects, rodents, fungi and unwanted plants in agriculture field (Akase *et al.* 2018). Most of the pesticide poisoning in animals occurs due to misuse or accidental exposure (Wang *et al.* 2007). Trends of poisoning in human or animals varies from place to place, and over time due to changes in access to poison, effective and timely medical management and preventive measures as well as regulatory policies (Karunarathne *et al.* 2021). India is an agrarian country with majority of farmers rearing livestock animals as subsidiary business to agriculture. Simultaneous interventions are being carried out with respect to agriculture as well as animal husbandry practices. Owing to intensive use of agrochemicals during cultivation of various crops, chances of animal exposure to pesticides can also increase. This is the first report depicting epidemiological data regarding agrochemical poisoning in bovines in India.

All the clinical cases of agrochemical poisoning were

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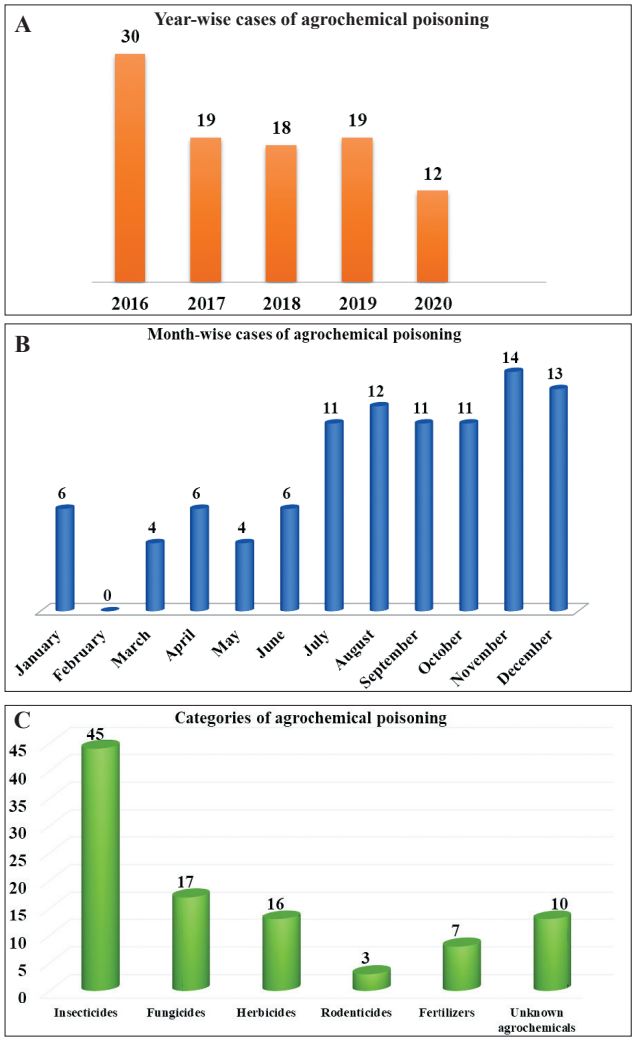

Fig. 1. (A) Year-wise distribution of cases of agrochemical poisoning in bovines; (B) Month-wise occurrence of cases of agrochemical poisoning in bovines; (C) Occurrence of agrochemical poisoning with respect to agrochemical classes in bovines.

confirmed on the basis of evidence provided by animal owners and admitted to VCC were categorized as per chemical classification of pesticides. Total of 98 cases of agrochemical poisoning were confirmed in bovines out of total 24,510 bovine cases admitted to Veterinary Clinical Complex from 2016 to 2020 indicating overall hospital prevalence of 0.39%. Year-wise distribution of agrochemical poisoning in bovines has been depicted in Fig. 1A. Year-wise highest number of cases of pesticide poisoning were reported during 2016 (30.16 %) followed by 2017, 2019 (19.38 % each), 2018 (18.36 %) and least during 2020 (12.24 %). Month-wise occurrence of agrochemical poisoning in bovines has been depicted in Fig. 1B. Month-wise highest number of pesticide poisoning cases were reported in November (14.28%), December (13.26%), July, September, October (11.22% each), January, April, June (6.12% each) and March, May (4.08% each) while no case was reported in the month of February. Season-wise distribution of agrochemical poisoning in bovines has been depicted in Table 1. Season-wise analysis of data showed highest occurrence of 40.81% poisoning cases during monsoon followed by 24.48% in post-monsoon, 19.38% during winter and least occurrence of 15.30% during summer season. Few detailed studies have been available in foreign countries with respect to poisoning in animals and will be used for discussion on findings of the present study. McLean and Hansen (2012) reported 28% occurrence of poisoning cases in summer followed by 25% each in spring and fall while 22% cases were reported in the winter. Lahmar *et al.* (2019) reported highest occurrence of poisoning in animals in months of December followed by March, June and August with least occurrence during February, April, May, July, September and October with no cases in months of January and November. In the present study highest occurrence of poisoning in animals was reported from July to December (Monsoon to post-monsoon) months which might be attributed to initiation of cultivation at the start of monsoon and harvesting of crops as well as sowing operations of rabbi season in the study region. Decline in poisoning cases during 2020 compared to rest of study period might be attributed to restrictions on transportation as well as other activities in country in view of COVID-19 pandemic.

Table 1. Season-wise distribution of agrochemical poisoning in bovines

Season	No. affected (n=98)	Per cent affected (%)
Monsoon	40	40.81
Post-monsoon	24	24.48
Winter	19	19.38
Summer	15	15.30

Age-wise occurrence of agrochemical poisoning in bovines has been depicted in Table 2. Age-wise occurrence of poisoning revealed highest cases in animals in >4-6 year age group (30.61%) followed by 0-2 year age group (28.57%), >6 year age group (22.44%) and least in >2-4 year age group (18.36%). Species-wise occurrence of poisoning revealed 64 cases (65.31%) in cattle while 34 cases (34.69%) in buffaloes. Among cattle 43 (67.18%) male animals were affected while 21 (32.82%) female animals were affected. On the contrary, all affected buffaloes were female. Akkina and Estberg (2018) reported highest occurrence of pesticide poisoning in equines (33%) followed by poultry (26%), bovine (25%), caprine (8%), porcine (6%), ovine (2%) and least (0.5%) in camelids. Wang *et al.* (2007) reported 47.2% poisoning cases in dogs, 34.1% in cats, 9.8% in other species (horses, cows, sheep, pigs or even rabbits) while in 8.9% cases of

Table 2. Age-wise occurrence of agrochemical poisoning in bovines

Age group	No. affected (n=98)	Per cent affected (%)
0-2 years	28	28.57
>2-4 years	18	18.36
>4-6 years	30	30.61
>6 years	22	22.44

Table 3. Pesticide class-wise occurrence of agrochemical poisoning in bovines

Pesticide class	No. affected	Per cent affected (%)
Organophosphates	41	41.83
Fungicides	17	17.34
Pyrethroids	6	6.12
Macrocyclic Lactones	6	6.12
Urea	6	6.12
Synthetic auxins	5	5.10
Organochlorines	3	3.06
Zinc phosphide rodenticide	3	3.06
Diammonium phosphate	1	1.02

poisoning the animal was not specified. Caloni *et al.* (2016) reported highest occurrence of pesticide poisoning in dogs (71.1%) followed by cats (15.8%) with limited number of cases involved horses, goats and sheep. In the present study only cattle and buffaloes were included in selection criteria, so it will be difficult to justify the trend of pesticide poisoning with respect to animal species. Maximum cases of poisoning were reported in cattle compared to buffaloes in the present study. The male cattle are predominantly utilized for draught work and cows are being reared for the purpose of milk production. On the contrary, buffaloes are solely used for milk production in the study region. Owing to increased chances of exposure of both male and female cattle to pesticides compared to only female buffaloes, the occurrence of pesticide poisoning might be higher in cattle.

The occurrence of agrochemical poisoning in bovines with respect to agrochemical classes has been depicted in Fig. 1C. Agrochemical class-wise prevalence of poisoning in bovines revealed the highest occurrence of insecticide poisoning (45.91%) followed by fungicide (17.34%), herbicide (16.32%) and fertilizers (7.14) while least prevalence was recorded for rodenticide (3.06%) category. Pesticide class-wise occurrence of agrochemical poisoning in bovines has been depicted in Table 3. Among various pesticide classes and fertilizers, organophosphates were responsible for 41.83% cases, fungicides for 17.34%, pyrethroids, macrocyclic lactones and urea for 6.12% each, synthetic auxins for 5.10%, organochlorines and zinc phosphide rodenticides for 3.06% and diammonium phosphate for 1.02% cases of agrochemical poisoning. Among various pesticides, highest occurrence of poisoning cases due to insecticides in the present study are in agreement with the findings of several authors who also reported insecticide poisoning as a major cause of pesticide poisoning in animals. Wang *et al.* (2007) reported 50.3% cases of carbamate insecticides, 18.9% cases of rodenticides with anticoagulants, 5.1% cases of organophosphate insecticides, 3.4% cases of rodenticide non-anticoagulant while 22.3% cases of molluscicide and herbicide poisoning in domestic and livestock animals over a period of 6 years in Austria out of 175 confirmed cases of poisoning. In a retrospective study carried out in Italy, Caloni *et al.* (2016) reported highest exposure of animals to insecticide (40.8%) poisoning followed by rodenticide poisoning (27.6%), herbicides poisoning (14.2%), molluscicides (11.5%) and fungicides (5.9%) poisoning. Lahmar *et al.* (2019) reported pesticide poisoning in animals with 52.4% cases due to carbamates, 19% due to organophosphates and 28.6% cases due to rodenticide poisoning in domestic and livestock animals. Similarly, Akkina and Estberg (2018) reported highest occurrence of insecticide poisoning (2151 cases) followed by herbicides (839 cases), rodenticides (765) and fungicides (286 cases) among various pesticide poisoning in livestock animals. The findings of the present study are more or less in agreement with those of Akkina and Estberg (2018) who exclusively studied epidemiology of pesticide poisoning in livestock animals. The trend of pesticide poisoning in livestock animals may be attributed to agriculture operations and permitted pesticides for use in particular country or region. Among various pesticides, use of insecticides and herbicides was observed more in comparison to other agrochemicals.

In case of insecticide poisoning, the highest occurrence of poisoning was observed due to accidental grazing on insecticide sprayed crops or ingestion of dry forages contaminated with insecticides primarily used for rodent control during harvesting season (57.77%). The other common method of exposure was accidental ingestion of insecticide solutions prepared for pesticide spray in crops (26.66%). Accidental use of insecticides for the management of ectoparasites on animal body contributed to around 8.88% insecticide poisoning cases, while 6.66% cases of insecticide poisoning occurred due to accidental access to raw pesticide in animal shed or near the crop fields. In case of herbicide poisoning, accidental grazing in herbicide sprayed crops (56.25%) followed by accidental ingestion of herbicide solution prepared for crop spraying (37.5%) and accidental use of herbicide for the treatment of ectoparasitic infestation on animal body (6.25%) were the types of exposure reported. Spraying of pesticides was mainly performed on soybean and pigeon pea crops during monsoon and post-monsoon season in the study region. In case of fungicide poisoning, accidental ingestion of raw fungicide powder during kharif season was found responsible for 88.23% cases of poisoning while 11.77% cases occurred due to ingestion of fungicide treated seeds. In case of fertilizer and rodenticide poisoning, accidental access to agrochemical in animal shed premises was the cause of poisoning. Unscientific handling and improper storage and use of pesticides followed by grazing on pesticide sprayed crops/ grasses found to be major reasons for causing toxicity in bovines.

Insecticides, herbicides, fungicides, fertilizers and rodenticides were the important classes of agrochemicals found responsible for poisoning in cattle and buffaloes in the present study. Accidental ingestion of carelessly disposed fungicide packets in agriculture field during sowing seasons, accidental ingestion of pesticide sprayed forages, accidental access to prepared solutions of pesticides, unscientific use of pesticides for the treatment of ectoparasitic infestation

in cattle and accidental access to fertilizers in cattle shed or in agriculture land were found as the most common causes of agrochemical poisoning in cattle and buffaloes. An epidemiological data from the present study will be helpful for paving the way for conducting more detailed studies on agrochemical poisoning in animals in India and will be helpful to suggest necessary interventions to reduce the exposure of animals to agrochemicals in order to reduce the occurrence of poisoning.

SUMMARY

In view of unavailability of data on agrochemical poisoning in livestock animals in India, the present work was conducted with objective to study the epidemiological aspects of agrochemical poisoning in bovines over a period of five years. A total of 98 cases of pesticide poisoning in bovines have been reported during 2016-2020 at Veterinary Clinical Complex, College of Veterinary and Animal Sciences, Udgir with hospital prevalence of 0.39%. Among various agrochemicals, insecticide poisoning was responsible for 45.91% cases, fungicide for 17.34%, herbicides for 16.32%, unknown pesticides for 10.20%, fertilizers for 7.14% and rodenticides for 3.06% cases of poisoning in bovines. Year-wise higher number of cases were reported during 2016 (30.61%) followed by 2017, 2019 (19.38% each) and 2018 (18.36%) while, month-wise highest number of poisoning cases were reported in months of November (14.28%), December (13.26%), July and September, October (11.22% each). Season-wise highest occurrence of poisoning was observed during monsoon and post-monsoon seasons while least occurrence was observed during summer season. Age-wise highest occurrence of agrochemical poisoning was reported in 4-6 year and 0-2 year age-group animals. Species-wise occurrence of poisoning revealed highest occurrence in cattle (65.31%) than buffaloes (34.69%). Among cattle 67.18% male animals while 32.82% female animals were affected. All buffaloes confirmed for poisoning were female. The findings of the present study will be helpful for formulating strategies to reduce exposure of livestock animals to agrochemicals.

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