

## **Pesticides Occupational Exposure in Riyadh, Kingdom of Saudi Arabia: Knowledge, Attitudes and Practices.**

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**Abstract.** Knowledge, attitudes and practices (KAP) of the workers in charge of public health pests control in Riyadh municipality were evaluated in this study. A self-administered questionnaire was completed by 53 workers aged  $\geq 22$  years old. The results revealed that most of them (92.2%) received their information regarding pesticides from their relatives, friends or neighbors. The organophosphorus insecticide, temephos, was the most well known applied pesticide to the workers. A great majority ( $> 92\%$ ) believed that the pesticide label is important and the instructions must be read and followed. Knowledge of proper storage methods was high, but knowledge of proper disposal of pesticide leftover or empty containers was low. Many workers had toxicity symptoms related to occupational exposure to pesticides. So, special training as well as educational programs and legislation promoting the use of safer disposal methods are necessary to reduce the risk of poisoning that may result from exposure to pesticides.

### **Introduction**

Pesticides are toxic chemicals widely used throughout the world to control medical and agricultural pests. The indiscriminate use of these chemicals constitutes one of the main public health problems in developing countries (Koh and Jeyaratnam, 1996). People in developing countries comprise more than 75% of the world total population (El-Sebae, 1993). These developing countries use about 20% of the pesticides in the world; this percentage is increasing. The yearly worldwide prevalence of acute pesticide poisonings has been estimated at about one million unintentional and two millions intentional cases, with approximately 220,000 deaths (WHO/UNEP, 1990). The majority of these cases occur in developing countries. Lack of legislative requirements, poor information systems, lack of diagnostic facilities and regular health surveillance, and misdiagnosis are main reasons for under-reporting of acute poisoning cases in developing countries (Loevinsohn, 1987; Mbakaya, 1994; London and Myers, 1995; Keyfer *et al.*, 1996). It should also be noted that most of the less severe cases not requiring hospital care are usually not reported. The exposure of pest control workers to pesticides is the most relevant occupational hazard of

pesticides use, primarily in developing countries (Van der Hoek *et al.*, 1998; Hurtig *et al.*, 2003). Epidemiological studies regarding pesticides are considered important in order to decrease pesticide risk and to help in designing proper public health policies (WHO, 1991). The workers' knowledge of pesticide use, handling and hazards is important for the prevention of acute and chronic poisoning. Therefore this research was conducted to study the prevalence of measures of these items among pesticide workers in Riyadh city.

### **Materials and Methods**

This was a cross-sectional knowledge, attitudes, and practices (KAP) study. Its scope covers those who work in the public health pest control in Riyadh municipality, Saudi Arabia. Riyadh city was selected because it has high population density compared to the other cities and continuous control of public health pests is important. There are 250 workers involved in pesticides application in Riyadh municipality. A random sample of 53 workers was selected. A self-administered questionnaire was used to collect data about the respondents' social and demographic characteristics, knowledge, attitudes and

practices related to pesticides as well as toxicity symptoms or complaints following pesticide application. The questionnaire was tested with 17 workers who did not participate in the final study using Cronbach's coefficient which was 0.9 for knowledge and 0.8 for practice questionnaires. Respondents' answers were recorded on scales constructed for each item. Data was entered and analyzed in Statistical Package for Social Sciences (SPSS). Descriptive statistics were performed for mean scores, percentages and standard deviations.

## Results and Discussion

### Social and demographic features

Social and demographic features of pest control workers in Riyadh municipality are presented in Table 1. Most workers (66%) interviewed were middle-aged, between 25 and 50 years old, with median age of 32.4 years. Their level of education was low, about two-fifths (41.5%) of the workers had never been to school, (24.5% were illiterate and 17% were able to read and write), 28.3% had primary education and 24.5% attended secondary schools. Low levels of education among pesticide worker populations have also been observed in Ethiopia (Mekonen *et al.*, 2002), Lebanon (Salameh *et al.*, 2004) and Brazil (Recena *et al.*, 2006). More than 60% of workers engaged in public health pests control for 5 to 10 years. Most workers are married (71.7%) and have children (family size is 5.8); however, the respondents' average monthly income (1194.4 SR) is low. Illiteracy, poverty, and lower sanitation and medical care standards result in higher health risks during occupational, accidental, and long-term exposure to pesticides and their residues (Kimani and Mwanthi, 1995).

### Knowledge, attitudes, and practices regarding the use of pesticides

Workers' information sources regarding pesticides (Table 2) were most received through oral communications with friends, relatives or neighbors (92.2%) where the maximum mean on knowledge scale was (2.77), by experience (72%) and from pesticide label (66%). Lower proportions (37.8%) received information from extension brochures. About 24.5% of the workers gained their information from health advisors or research centers. The overall mean (*M*) obtained on the knowledge scale for workers' information source was low (1.25) with standard deviation (*SD*) of 0.69. This is a result of the low education level of involved subjects. Absence of the formal role of extension centers, media programs,

and health advisors is another reason limiting sources of pesticide information to oral communication. So, extension centers, health advisors and media must play a greater role as important sources of knowledge regarding the safe handling and use of pesticides especially for occupational exposed workers.

**Table 1. Social and demographic features of the workers**

| Characteristics                  | <i>M</i> ( <i>SD</i> ) <sup>a</sup> | <i>N</i> = | %    |
|----------------------------------|-------------------------------------|------------|------|
|                                  |                                     | <b>53</b>  |      |
| Age (years)                      | 32.4(10.4)                          |            |      |
| ≤ 25                             |                                     | 14         | 26.4 |
| >25 and ≤ 50                     |                                     | 35         | 66   |
| > 50                             |                                     | 4          | 7.5  |
| Education                        |                                     |            |      |
| Illiterate                       |                                     | 13         | 24.5 |
| Able to read and write           |                                     | 9          | 17   |
| Primary                          |                                     | 15         | 28.3 |
| Secondary                        |                                     | 13         | 24.5 |
| University                       |                                     | 3          | 5.7  |
| Marital status                   |                                     |            |      |
| Single                           |                                     | 12         | 22.6 |
| Married                          |                                     | 38         | 71.7 |
| Divorced                         |                                     | 3          | 5.7  |
| Monthly income (SR) <sup>b</sup> | 1194.4 (1185.8)                     |            |      |
| ≤ 1000                           |                                     | 35         | 66   |
| > 1000                           |                                     | 18         | 34   |
| Family size                      | 5.8 (3.27)                          |            |      |
| ≤ 5                              |                                     | 33         | 62.3 |
| > 5                              |                                     | 20         | 37.7 |
| Duration of work (years)         | 6.5 (6.28)                          |            |      |
| < 5                              |                                     | 15         | 28.3 |
| 5-10                             |                                     | 32         | 60.4 |
| > 10                             |                                     | 6          | 11.3 |

<sup>a</sup> *M*, mean; *SD*, standard deviation; <sup>b</sup> SR, Saudi Riyals.

**Table 2. Pesticide information sources**

| Source   | Mean ( <i>SD</i> ) | <i>N</i> = 53 | %    |
|--|--------------------|---------------|------|
| Oral communication (relatives, friends or neighbors) | 2.77 (0.58)        | 49            | 92.2 |
| Personal experience                                  | 2.16 (1.29)        | 38            | 72   |
| Pesticide label                                      | 1.98 (1.18)        | 35            | 66   |
| Pesticides manufacturer                              | 1.75 (1.32)        | 31            | 58.5 |
| Pesticides dealer                                    | 1.19 (1.03)        | 21            | 39.6 |
| Extension brochures                                  | 1.13 (0.80)        | 20            | 37.8 |
| Newspapers and magazines                             | 0.96 (0.69)        | 17            | 32.1 |
| TV programs  | 0.79 (0.59)        | 14            | 26.4 |
| Extension movies                                     | 0.73 (0.58)        | 13            | 24.5 |
| Health advisors                                      | 0.73 (0.58)        | 13            | 24.5 |
| Research centers                                     | 0.73 (0.46)        | 13            | 24.5 |
| Extension centers                                    | 0.68 (0.48)        | 12            | 22.6 |
| Radio programs                                       | 0.68 (0.51)        | 12            | 22.6 |
| <i>M</i>   | 1.25 (0.69)        |               |      |

*M* is the overall mean on knowledge Scale of: 0 = Not found, 1 = Rarely, 2 = Sometimes, 3 = Always.

Table 3 represents the most frequently used insecticides. Temephos, an organophosphorus insecticide, was the most often used by workers (94.3%) while malathion was the least used (22.6%).

Means on the knowledge scale ranged from 3.77 to 0.9 and the overall mean ( $M$ ) was 2.08. Table 4 shows the workers knowledge about pesticide application equipments used. Thermal fogger on vehicle, high pressure sprayers and ULV on vehicle were the most often used (94.3, 92.4 and 90.6% respectively) as workers reported. Table 5 represents attitudes of the workers towards information included in the pesticide label. Most workers believed that the pesticide label is important and the included instructions must be read and followed (>90%). The obtained  $M$  on the attitude scale for workers' attitudes toward pesticide label information was 4.49 of 5 with  $SD$  of 0.27. Label information that well known by the majority of the workers was the production and expiration dates (>94%), while lower proportion (58.5-69.8%) had knowledge about effect on non-target organisms, disposing of empty containers, prevention of pollution, toxicity symptoms, handling, and using instructions. The obtained  $M$  on a knowledge scale for workers' knowledge regarding pesticide label information was 1.37 of 2 with  $SD$  of 0.23. Table 6 shows pesticide storage and disposal methods practiced by the workers. Pesticides were kept usually in sealed containers (100%) and in their original containers (98.1%).

**Table 3. Pesticides frequently used by the workers**

| Pesticide                     | Mean (SD)   | N = 53 | %    |
|-------------------------------|-------------|--------|------|
| Temephos                      | 3.77 (0.71) | 50     | 94.3 |
| Permethrin                    | 2.77 (0.78) | 37     | 69.8 |
| Diazinon                      | 2.72 (0.83) | 36     | 67.9 |
| Fenitrothion                  | 2.56 (0.88) | 34     | 64.1 |
| Deltamethrin                  | 2.49 (0.75) | 33     | 62.3 |
| Cypermethrin                  | 2.34 (0.93) | 31     | 58.4 |
| Lambda-cyhalothrin            | 2.34 (0.84) | 31     | 58.4 |
| <i>Bacillus thuringiensis</i> | 1.81 (0.64) | 24     | 45.3 |
| Premiphos-methyl              | 1.81 (0.95) | 24     | 45.3 |
| Alpha-cypermethrin            | 1.81 (0.87) | 24     | 45.3 |
| Chlorpyrifos                  | 1.74 (0.91) | 23     | 43.4 |
| Fenvalerate                   | 1.74 (0.88) | 23     | 43.4 |
| Bioallethrin                  | 1.64 (0.83) | 22     | 41.1 |
| Byriproxyfen                  | 1.43 (0.82) | 19     | 35.8 |
| Diflorobenzuron               | 1.43 (0.82) | 19     | 35.8 |
| Malathion                     | 0.90 (0.27) | 12     | 22.6 |
| $M$                           | 2.08 (0.68) |        |      |

$M$  is the overall mean on Knowledge Scale of: 1 = Not used, 2 = Rarely, 3 = Sometimes, 4 = Always.

Most workers store the pesticides in a separate building (98.1%) and the containers were placed on wood stands (90.6%). Majority of workers use all purchased amount (90.6%). Dumping in the soil was reported by 69.8% of workers. Only 30.2% call special disposal companies or return the pesticide leftover to the original company (Table 6). The obtained  $M$  on a knowledge scale for workers storage knowledge was high (2.66) with  $SD$  0.25, while the

obtained  $M$  on a knowledge scale for workers disposal knowledge was low (1.23 of 3) with  $SD$  0.65.

**Table 4. Workers' knowledge about pesticides application equipments**

| Equipment                 | Mean (SD)   | N = 53 | %    |
|---------------------------|-------------|--------|------|
| Thermal fogger on vehicle | 3.77 (0.73) | 50     | 94.3 |
| High pressure sprayer     | 3.70 (0.72) | 49     | 92.4 |
| ULV on vehicle            | 3.62 (0.94) | 48     | 90.6 |
| Hand thermal fogger       | 3.17 (1.24) | 42     | 79.2 |
| Low pressure sprayer      | 3.17 (1.28) | 42     | 79.2 |
| Discrete pressure sprayer | 3.02 (1.35) | 40     | 75.5 |
| Portable sprayer          | 3.02 (1.43) | 40     | 75.5 |
| Granule disperser         | 1.58 (1.09) | 21     | 39.6 |
| Hand ULV                  | 1.36 (0.79) | 18     | 33.9 |
| Constant pressure sprayer | 1.06 (0.52) | 14     | 26.4 |
| $M$                       | 2.8 (0.97)  |        |      |

$M$  is the overall mean on Knowledge Scale: 1 = Not used, 2 = Rarely, 3 = Sometimes, 4 = Always.

**Table 5. Attitudes and Knowledge of workers with regard to pesticide label**

| Attitudes and knowledge                      | Mean (SD)   | N = 53 | %    |
|--|-------------|--------|------|
| Importance of the label                      |             |        |      |
| The label is important                       | 4.81 (0.43) | 51     | 96.2 |
| The label must be read                       | 4.62 (0.53) | 49     | 92.4 |
| Instructions on the label must be followed   | 4.62 (0.49) | 49     | 92.4 |
| The label is a result of scientific research | 4.25 (0.85) | 45     | 84.9 |
| The label is a tool for pest control         | 4.15 (0.48) | 44     | 83   |
| $M^a$  | 4.49 (0.27) |        |      |
| Label information <sup>b</sup>               |             |        |      |
| Production and expiration date               | 1.89 (0.33) | 50     | 94.3 |
| Safety                                       | 1.74 (0.45) | 46     | 86.8 |
| Target pest                                  | 1.43 (0.50) | 38     | 71.7 |
| Using instructions                           | 1.28 (0.46) | 34     | 64.1 |
| Trade name                                   | 1.28 (0.46) | 34     | 64.1 |
| Handling                                     | 1.28 (0.46) | 34     | 64.1 |
| Toxicity symptoms and primary care           | 1.28 (0.46) | 34     | 64.1 |
| Disposing of empty containers                | 1.21 (0.43) | 32     | 60.3 |
| Effects on non target organisms              | 1.17 (0.39) | 31     | 58.5 |
| Prevention of pollution                      | 1.17 (0.39) | 31     | 58.5 |
| $M^b$  | 1.37 (0.23) |        |      |

<sup>a</sup> is the overall mean on attitude scale of: 1= Completely disagree, 2= Disagree, 3= Not defined, 4= Agree, 5= Completely agree.

<sup>b</sup> is the overall mean on knowledge scale of: 1= I know, 2= I don't know.

## Prevention measures

In Table 7, safety measures taken by the workers during pesticide handling and application are described. A large proportion (>90%) spray pesticides in specific times, stop spraying during windy days, spray down wind, avoid spraying in public area, take a shower at the end of the work, store pesticides away from labors' house, measure wind speed before application, and clean the equipment at the end of application. A lower proportion did not eat, drink or smoke during

application, check the expire date, wash application clothes separately (88.7%). Most workers wear gloves (81.1%), hats, boots, face masks and eye glasses (79.2%). Wearing impermeable safety clothes during application was reported by 77.3%. Those who calibrate the application equipments were just 54.7%. The obtained *M* on a practice scale for workers safety measures was adequate (3.45 of 4) with *SD* 0.40.

**Table 6. Storage and disposal practices**

| Practice   | Mean (SD)   | N = 53 | %     |
|--|-------------|--------|-------|
| <b>Storage</b>   |             |        |       |
| In sealed container  | 3.00 (0.14) | 53     | 100   |
| In original container  | 2.94 (0.24) | 52     | 98.1  |
| Storage building should be separate  | 2.94 (0.42) | 52     | 98.1  |
| Water resource and detergents should be inside the store                                       | 2.83 (0.62) | 50     | 94.3  |
| Storage should be provided with ventilation system   | 2.77 (0.79) | 49     | 92.4  |
| Containers should be on wood stands  | 2.72 (0.69) | 48     | 90.6  |
| Personal protection equipments, drinks,...etc. should not be stored inside the pesticide store | 2.61 (0.98) | 46     | 86.8  |
| Fire extinguisher and alarm  | 2.49 (1.10) | 44     | 83.0  |
| Purchase and store the exact amount that needed  | 2.43 (0.64) | 43     | 81.1  |
| Label the store doors with caution signs   | 2.37 (1.13) | 42     | 79.2  |
| Inspecting the containers periodically   | 2.21 (0.79) | 39     | 73.6  |
| <i>M<sup>a</sup></i>   | 2.66 (0.25) |        |       |
| <b>Disposal</b>  |             |        |       |
| Using all purchased amount   | 2.70 (0.73) | 48     | 90.6  |
| Dumping under the soil surface   | 2.10 (1.30) | 37     | 69.8  |
| Reuse  | 1.13 (0.93) | 20     | 37.73 |
| Call special disposal companies  | 0.91 (0.69) | 16     | 30.2  |
| Return pesticide leftover to the original company  | 0.91 (0.69) | 16     | 30.2  |
| Burning in special ovens   | 0.85 (0.66) | 15     | 28.3  |
| Burning in the air   | 0.85 (0.63) | 15     | 28.3  |
| Dilute pesticides with other materials   | 0.85 (0.59) | 15     | 28.3  |
| Spray diluted pesticides on unusable soil surface  | 0.79 (0.65) | 14     | 26.4  |
| <i>M<sup>b</sup></i>   | 1.23 (0.65) |        |       |

<sup>a</sup> is the overall mean on knowledge scale of: 1 = Rarely, 2 = Sometimes, 3 = Usually.

<sup>b</sup> is the overall mean on knowledge scale of: 0 = Not used, 1 = Rarely, 2 = Sometimes, 3 = Always.

### Toxicity symptoms after pesticides application

Health complaints of workers after pesticides application are shown in Table 8. Skin itching, headache, and coughing were the common symptoms felt by 60.4, 58.5, and 56.6% of respondents respectively. Lower proportions of workers complained of sweating (41.5%) and about 35.8% had difficult breathing, fatigue, bleeding nose, and

blurring of vision. Weight loss, throat, and deformity of nails were the least symptoms reported by the workers. Complaints reported by the individuals in this study, such as fatigue, headache, dizziness, blurring of vision, and vomiting are typical of exposure to formulations containing pesticides, including the organophosphorus insecticides (Smit *et al.*, 2003).

**Table 7. Safety measures practiced by the workers**

| Precaution  | Mean (SD)   | N = 53 | %    |
|---|-------------|--------|------|
| Spray in specific times                               | 3.84 (0.72) | 51     | 96.2 |
| Stop spraying during windy day                        | 3.84 (0.72) | 51     | 96.2 |
| Spraying down wind                                    | 3.77 (0.73) | 50     | 94.3 |
| Spray car moving very slow as recommended             | 3.77 (0.75) | 50     | 94.3 |
| Stop spraying in public area                          | 3.77 (0.75) | 50     | 94.3 |
| Store pesticide away from labors house                | 3.77 (0.81) | 50     | 94.3 |
| Operation pressure is stable                          | 3.77 (0.73) | 50     | 94.3 |
| Take a shower after application                       | 3.70 (0.83) | 49     | 92.4 |
| Clean spraying equipments after finish                | 3.70 (0.91) | 49     | 92.4 |
| Spraying on specific and constant baths               | 3.62 (0.90) | 48     | 90.6 |
| Measure wind speed before pesticide application       | 3.62 (0.91) | 48     | 90.6 |
| Avoid smoking, drinking, or eating during application | 3.55 (0.92) | 47     | 88.7 |
| Check the expire date                                 | 3.55 (1.04) | 47     | 88.7 |
| Wash the application clothes separately               | 3.55 (1.04) | 47     | 88.7 |
| Wear Gloves   | 3.24 (1.31) | 43     | 81.1 |
| Wear head cover                                       | 3.17 (1.35) | 42     | 79.2 |
| Wear boots  | 3.17 (1.35) | 42     | 79.2 |
| Wear mask for mouth and nose                          | 3.17 (1.29) | 42     | 79.2 |
| Wear eye glasses                                      | 3.17 (1.38) | 42     | 79.2 |
| Drink milk when the work done                         | 3.17 (1.30) | 42     | 79.2 |
| Wear safety clothes                                   | 3.09 (1.38) | 41     | 77.3 |
| Use special devices for mixing                        | 3.02 (1.39) | 40     | 75.5 |
| <i>M</i>  | 3.45 (0.40) |        |      |

*M* is the overall mean on practice scale of : 1= Not found, 2= Rarely, 3= Sometimes, 4= Always.

**Table 8. Health complaints of workers**

| Complaint                       | N = 53 | %    |
|---------------------------------|--------|------|
| Skin itching                    | 32     | 60.4 |
| Headache                        | 31     | 58.5 |
| Coughing                        | 30     | 56.6 |
| Sweating                        | 22     | 41.5 |
| Difficult breathing             | 19     | 35.8 |
| Fatigue                         | 19     | 35.8 |
| Bleeding nose                   | 19     | 35.8 |
| Blurring of vision              | 19     | 35.8 |
| Dizziness                       | 17     | 32.1 |
| Changes in mood                 | 17     | 32.1 |
| Sleeplessness                   | 16     | 30.2 |
| Vomiting                        | 16     | 30.2 |
| Forgetfulness, memory disorders | 15     | 28.3 |
| Throat                          | 14     | 26.4 |
| Weight loss                     | 14     | 26.4 |
| Deforming of nails              | 13     | 24.5 |

Despite of the low global education level of involved subjects in this study and the limited sources of information, the workers' knowledge related to pesticide label information or their attitudes towards the importance of this label was adequate to some

extent. However, lack of some information was observed. The majority of workers (92.4%) reported that the label must be read and followed but only 64.1% reported that the label information includes using instructions, handling procedures or toxicity symptoms and primary care. Using of protective measures was partially followed, except the disposal of empty containers or pesticide leftover which was poor. The KAP assessment in other developing countries revealed results similar to our findings. In Gaza, high level of knowledge of pesticides was reported, but the use of protective measures was inadequate (Yassin *et al.*, 2002).

Information, instructions, and training of pesticide-exposed workers should be promoted since these activities are fundamental aspects of health protection (Salameh *et al.*, 2004). Occupational safety and health intervention may involve engineering, administrative, and individual behavior change strategies (Heaney and Goldenha, 1996). WHO has recommended the use of pesticides only by trained people (WHO, 1991). An action oriented approach to pesticide workers education should be taken as in Nicaragua and Puerto Rico. In these countries, the workers were educated about the hazards and safe use of pesticides, as well as empowering them to take preventive and protective actions and this gave a positive outcome (Weinger and Lyons, 1992). Toxicity symptoms reported in the Table 8 indicate that the fitness of the personal protective equipments (PPE) must be checked.

In conclusion, educational and technical support that considers cultural and socioeconomic aspects of the workers exposed to pesticides are required to change the scenario observed in this study. Occupational safety measures against exposure to pesticides are necessary. Governmental intervention is also needed to ensure proper legislation regarding public health risks and hazards.

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قسم وقاية النبات، كلية علوم الأغذية والزراعة، جامعة الملك سعود  
ص.ب ٢٤٦٠، الرياض ١١٤٥١، المملكة العربية السعودية

(قدم للنشر في ١/٢/١٤٣٠هـ؛ وقبل للنشر في ٤/١٧/١٤٣٠هـ)

: مبيدات الآفات، التعرض المهني، وقاية، البطاقة الاستدلالية للمبيد.

. في هذه الدراسة تم تقييم المعارف و الاتجاهات والممارسات لدى العاملين في مجال مكافحة آفات الصحة العامة في أمانة الرياض. وقد تم جمع المعلومات باستخدام إستبانات تم ملؤها بواسطة ٥٣ عامل في الفئة العمرية ٢٢ عاما فأكثر. وأظهرت النتائج أن معظمهم يستقي معلوماته عن المبيدات من خلال الحوار مع الأصدقاء والجيران والأقارب وأن أكثر المبيدات المستخدمة والمعروفة لدى العاملين هو المبيد الفسفوري العضوي تيميفوس. كما أوضحت النتائج أن الغالبية العظمى من العاملين يؤمن بأهمية بطاقة المبيد وان التعليمات المدونة يجب أن تقرأ وان تتبع. كما اتضح أن معلومات العاملين عن التخزين السليم كانت جيدة بينما كانت معلوماتهم حول التخلص من الفائض أو العبوات الفارغة ضحلة. العديد من العاملين ظهرت عليه أعراض سمية مرتبطة بالتعرض المهني للمبيدات. لذلك يجب البدء في سن تشريعات وبرامج تدريبية وتعليمية لنشر الوعي حول الاستخدام الآمن وكيفية التخلص السليم من المبيدات الفائضة أو عبواتها الفارغة للتقليل من خطر التسمم نتيجة التعرض للمبيدات.