MAHARASHTRA AGRICULTURAL UNIVERSITIES EXAMINATION BOARD, PUNE

SEMESTER END THEORY EXAMINATION

B.Sc. (Hons.) Agriculture

Semester	**: VI (New)**	Term	**: VI**	Academic year	**: 2021-22**
Course No.	**: ELE SSAC-364**	Title	**: Agrochemicals**		
Credits	**: 3(2+1)**				
Day & Date	**:**	Time (hrs)	**: 14.30 to 17.30**	Total marks	**: 80**

Note:
1. Solve **ANY EIGHT** questions from **SECTION "A"**
2. All questions from **SECTION "B"** are compulsory.
3. All questions carry equal marks.
4. Draw neat diagrams wherever necessary.

MODEL ANSWERS

SECTION 'A'

Q.1	a.	Define agrochemicals. Write the types of pesticides used in agriculture with suitable example.	
		Agrochemicals : The chemicals used in agriculture to maintain or to increase the crop production. **Types of pesticides** : 1) Acaricides - Control of ticks and mites e.g. Sulphur and lime sulphur. 2) Algicides - Control of algae and other aquatic vegetation e.g. Copper sulphate. 3) Antiseptics - Non metal from microorganisms e.g. Phenol, mercuric chlorosis. 4) Arboricides - Undesirable arborell (vegetative part) and bushy vegetation e.g. Sulphuric acid, copper sulphate. 5) Bactericides - Control of bacteria and bacterial diseases e.g. Penicillin, streptomycin. 6) Fungicides - Plant diseases caused by various fungi e.g. Bordeux mixture, thiram. 7) Herbicides - Control of weeds e.g. 2,4-D, 2,4,5-T, diurea. 8) Insecticides - Control of harmful insects e.g. Endosulphan, carboryl. 9) Molluscides - Soft bodies insects like snails and slug. e.g. Metal dehyde. 10) Nematicides - Control of nematodes e.g. Methyl bromide and other fumigants. 11) Rodenticides - Control of rodents e.g. Zinc phosphide	(1) (3)
	b.	Write the adverse effect of agrochemicals on soil.	
		• Alter soil pH levels • Increases soil salinity and contamination • Increase nitrate content in the soil • Accumulation of heavy metals and their residual effect • Contamination of air and ground and surface water • Diffusion of agrochemicals in large water bodies lead to Eutrophication	(4)

		• Loss of soil biodiversity • They may kill bacteria and other organisms beneficial to the soil • Fumigants have adverse effect on soil fungi and actinomytes, there by slowing down the humas formation in soil. • Decreases the enzymatic action in soil	
Q.2	a.	Define fertilizers. Classify the phosphatic fertilizers with suitable examples.	
		Fertilizers- Any organic or inorganic material of natural or synthetic origin added to a soil to supply certain element essential for plant growth. **Classification of phosphatic fertilizers** : Phosphatic fertilizers are classified into three groups, depending on the form in which orthophosphoric acid/phosphoric acid is combined with calcium. **1. Water soluble/Monocalcium phosphate:** $Ca(H_2PO_4)_2$ i) Single super-phosphate - 16% P_2O_5 ii) Double super-phosphate - 32 % P_2O_5 iii) Triple super-phosphate - 48 % P_2O_5 iv) Ammonium phosphate - 11 % N + 52% P_2O_5 **2. Citric acid soluble/Dicalcium phosphate** ($CaHPO_4$) i) Basic slag - 14 to 18 % P_2O_5 ii) Tricalcium phosphate - 34% to 39 % P_2O_5 **3. Insoluble/Tricalcium phosphate** - $Ca_3(PO_4)_2$ i) Rock-phosphate - 20 to 40 % P_2O_5 ii) Raw bonemeal - 20 to 25 %10 P_2O_5 iii) Steamed bonemeal - 22 % P_2O_5	(1) (3)
	b.	Define complex fertilizers. Write the advantages of complex fertilizer.	
		The commercial fertilizers containing atleast two or more of the primary essential plant nutrients (N, P, K) are called as complex fertilizers. **Advantages:** 1. Easy for application 2. Balanced crop nutrition 3. High fertilizer efficiency 4. Even distribution of nutrients **5.** Saving of labor and time **6.** Safe for storage **7.** High analysis fertilizers	(1) (3)
Q.3	a.	Explain secondary nutrients and give sources of sulphur fertilizers.	
		Calcium, magnesium and sulphur are the examples of secondary nutrients. They are called "secondary" nutrients because plants require them in smaller quantities than major nutrients (nitrogen, phosphorus, and potassium). **Sources of fertilizers for Sulphur :** **Fertilizers** **Sulphur (%)** Ammonium sulfate 23 Potassium sulfate 18 Single Super phosphate 12 Gypsum 18 Magnesium sulfate 13	(2) (2)

		Alluminium sulfate 14	
	b.	Write the use and mode of action of triazole fungicide.	
		Use : • The triazoles are commonly used in grain crops as curative and preventative products. • They are particularly active against most rusts and have good preventative activity for fusarium head blight on grains. • They are also effective against powdery mildew and many foliar blights. **Mode of action :** Interfere with biosynthesis of sterols in fungal cell membrane; spore penetration and mycelial growth. They inhibit the formation of sterols, which are required for fungal cell wall formation, and thus are effective at preventing hyphal growth.	(2) (2)
Q.4	a.	Name the sources of water soluble fertilizers for major nutrients and give the benefits of water soluble fertilizers.	
		Sources of water soluble fertilizers for NPK/ major nutrients : **Nitrogenous fertilizer** Urea, Ammonium sulphate, Ammonium nitrate, Calcium nitrate **Phosphatic fertilizer** Mono ammonium phosphate, Phosphoric acid **Potassic fertilizer** Muriate of potash, Sulphate of potash **Benefits of liquid fertilizers** ➢ Ease of handling, ➢ Less labour requirement ➢ Possibility of mixing with herbicides have made the liquid fertilizers more acceptable to farmers. ➢ Liquid fertilizers has low price as compare to solid fertilizers. ➢ It allows accurate and even distribution. ➢ Higher efficiency than solid fertilizers, less leaching due to split application. ➢ It can be mixed with pesticides. ➢ By adding liquid fertilizers the droplet evaporation can be reduced and limits atmospheric pollution	(2) (2)
	b.	Write in brief on storage and handling of NPK fertilizers.	
		Handling and storage of fertilizers. Fertilizers differ in their ability to become moist or hygroscopic, as such they have to be handled during rainy season. Main features from storage point of view are as below. **Nitrogenous fertilizers:** i. Ammonium chloride : Excellent, no difficulty in storage and handling ii. Ammonium nitrate : Storage properties satisfactory but fertilizer is hygroscopic. So bags are firmly tied. As it is fire hazardous handle carefully. It is bagged in polythene lined jute bags as it is hygroscopic. iii. Urea : Storage properties satisfactory. Hygroscopic, store in polythene lined jute bags in dry place.	(4)

		iv. Ammonium sulphate and sodium nitrate : Storage properties good, no difficulties in handling & storage. **Phosphatic fertilizers:** **1. Single super phosphate:** i) It contains small amount of acid which deteriorate gunny bags, hence it should be stored in polythelene lined gunny bags. ii) Cakes formation in moist condition. **2. Dicalcium phosphate -** Excellent physical condition. **Potassic fertilizers:** Potassium sulphate and Potassium chloride: Excellent physical condition for storage and handling. Protect all fertilizer bags from moisture, water and rains. Protect bags against excessive sunshine .and heat by making use to shade of trees structures and covers.	
Q.5	a.	Define biofertilizer. Give the contribution of biofertilizers in agriculture.	
		Biofertilizers: Biofertilizers are defined as the preparations containing live or latent cells of efficient strains of nitrogen fixing, phosphate solubilising or cellulolytic microorganisms used for the application to seed, soil or composting areas with an objective of increasing numbers of such micro-organisms and to accelerate certain microbial processes to augment the extent of availability of nutrients in a form which can be easily assimilated by plants. **Contribution of Biofertilizer in Agriculture:** • They supplement fertilizer supplies for meeting the nutrients needs of crop. • They can add 20 – 200 kg N/ha under optimum conditions and solubilize / mobilize 30 – 50 kg P_2O_5/ ha. • They liberate growth promoting substances and vitamins and help to maintain soil fertility. • They suppress the incidence of pathogens and control diseases. • They increase crop yield by 10 – 50%. • They are cheaper and pollution free. • They improve soil health in general.	(2) (2)
	b.	Write the mode of action of organochlorine and carbamate insecticides.	
		Mode of action of organochlorine insecticides: Chlorinated hydrocarbons are neurotoxicants. Their application causes inhibition or inactivation in the functioning of Na- K ATPase and Ca-ATPase enzymes which are required for proper balance of Na and K in axon. The imbalance of these enzymes results in prevention of normal transmission of nerve impulse in insects and mammals. The imbalance of the enzymes ATPase and Ca-ATPase causing muscles to twist, this may lead to convulsion and death. **Mode of action of Carbamate insecticides** : Carbamate insecticides affects the enzyme choline esterase, which is responsible for removal of acetyl choline present in synapse (gap between nerve cell). This results in to continuous transmission of nerve impulses and loss of	(2) (2)

		coordination of nerves and other organs, giving rise to rapid twisting of voluntary muscles and finally paralysis of vital organs including lungs. Thus, failure of respiration due to paralysis of lungs is the main cause of death.	
Q.6	a.	Explain the degradation of pesticide and give the different measures to reduce the pesticide impact.	
		Degradation processes of pesticide : Degradation is the process of pesticide breakdown after application. Pesticides are broken down by microbes, chemical reactions, and light or photodegradation. This process may take anywhere from hours or days to years, depending on environmental conditions and the chemical characteristics of the pesticide. **Microbial breakdown** is the breakdown of chemicals by microorganisms such as fungi and bacteria. **Chemical breakdown** is the breakdown of pesticides by chemical reactions in the soil. **Photo-degradation**: It is the breakdown of pesticides by sunlight. All pesticides are susceptible to photo-degradation to some extent. **Measures to Minimize Pesticide Impact** : 1. Integrated Pest Management 2. Prevent back siphoning and spills 3. Consider weather and irrigation plans 4. Pesticide use and storage 5. Dispose of pesticide and chemical wastes safely 6. Leave buffer zones around sensitive areas 7. Reduce off-target 8. Maintain all application equipment in good working order and calibrate it regularly.	(2) (2)
	b.	Define fungicides and give the advantages and dis-advantages of bordeaux mixture.	
		Fungicides: All chemicals which kills or control pathogen directly or indirectly are called as fungicides. **Advantages of Bordeaux mixture**: • Very easy and can prepared by farmers themselves. • Can act as fungicide, bactericide and algaecide. • Applicable for control of different plant diseases such as foot rot, stem rot, leaf spot, leaf blight, anthracnose, canker, damping off, black spot, downy mildew, late and early blight etc. • The chemicals required for this is copper sulphate and lime which is easily available in the market. • All the diseases controlled by copper based fungicides such as leaf spot, blight diseases can be controlled by this. • It is less toxic to human as compare to other commercial fungicides **Disadvantages:** • It cannot be kept for long periods (More than 2 days after preparation).	(1) (2) (1)

		• It cannot be applied during the cold and cloudy weather, as it causes phytotoxicity to plants. • It cannot be applied to apple, maize and some of the dwarf rice varieties.	
Q.7	a	Write the chemical nature and use of Benzimidazole fungicide.	
		Chemical nature of Benzimidazole fungicides: Molecular formula: $C_7H_6N_2$: • It contains C, H and N • It is colourless solid • It is heterocyclic aromatic organic compound • Its bycyclic compound, view like two fused ring of Banzine and imadazol • Molar mass :118.139 g mol^{-1} • Melting point: 170 to 172 ^{0} C • Acidic in reaction • Acidity : pKa = 12.8 • It is condensation product of Phynylenediamine with formic acid or equivalent to trimethyl orthoformate **Use**: • They can control many ascomycetes and basidiomycetes, but not oomycetes. • They are applied to cereals, fruits, vegetables and vines, and are also used in postharvest handling of crops. • The benzimidazole fungicides are extensively used on a variety of crops (vegetables, fruits, nuts, cereals, cotton, ornamentals, mushrooms, and others) for numerous fungal diseases.	(2) (2)
	b.	Define herbicide. Write in brief the general mode of action of herbicides.	
		Herbicide: A herbicide in the broadest sense of word is any compound that is capable of either killing or severely injuring plants and may thus be used for elimination of plant growth or killing of plant parts. **General mode of action of herbicides.** 1) Photosynthetic poisons a) Interfere with Hill's reaction – In photolysis of water here is evolution of oxygen which is interfered by herbicides like triazines, carbamates, urea derivatives then interference will dead to no supply of oxygen. b) Some interference in Electron transport chain – herbicides like paraquat, diquat, Bipyrillidium, after several stages ……. 2) Those interfere with cellulor metabolisms – herbicides lil 2-4-D, phenoxy acids and benzoic acid series results in to an controlled growth leading to collapse of xylem, phloemce and plant die. 3) Interference in the protein metabolism – herbicides like butachlor interfere in protein metabolisum resulting in stunted root growth there by shortening of stem, etc. and plant may die.	(1) (3)

		4) Uncoupling of oxidative phosphorylation – herbicides like DNOC, MSMA and even arsenic containing herbicides inter in the oxidative phosphorylation process and there is no format of ATP. Plant does not set emerge and it dies.	
Q.8	a.	Write short notes 1. Insect growth regulators (IGRs) 2. Reduced risk insecticide	
		1. Insect growth regulators (IGRs): Insect growth regulators (IGRs) are pesticides that don't usually kill insects outright but instead affect the ability of insects to grow and mature normally. IGRs either block the insect's ability to turn into an adult or cause it to change into an adult before it is physically able to reproduce. Insect growth regulators (IGRs) are insecticides that mimic hormones in young insects. They disrupt the insects growth and reproduction. IGRs can control many types of insects including fleas, cockroaches, and mosquitos. IGRs are generally low in toxicity to humans. **2. Reduced risk insecticide:** Reduced-risk pesticides are newer classes of compounds that pose a lower health risk to humans and the environment.The environmental Protection Agency (EPA) technically defines a Reduced-risk pesticide use as one which "may reasonably be expected to accomplish one or more of the following": 1. Reduces pesticide risks to human health; 2. Reduces pesticide risks to non-target organisms; 3. Reduces the potential for contamination of valued, environmental resources, 4. Broadens adoption of IPM or makes it more effective. EPA implemented the Reduced-Risk Pesticides Initiative in 1993 to provide incentives to encourage the development and registration of pesticides that present lower risks to public health and the environment, and to encourage the replacement of higher risk pesticides in the marketplace.	(2) (2)
	b.	Explain botanical insecticides and give the advantages and dis-advantages of botanical insecticides.	
		Botanical insecticides: Plant materials used as insecticides are known as botanical insecticides. The toxicant may be present in any part of the plant and these toxic materials are collected and dried and powdered and that powder is used as insecticide. The toxicant also extracted from the powder using some solvent and chemical compound thus obtained used as insecticide. **Advantages of botanical insecticides** • Relatively cheaper • Don't pollute the environment • Don't leave any residue • Availability is relatively easier • Don't harm the beneficial organisms. **Disadvantages or difficulties involved in the use of botanical insecticides:** • It takes fairly long time (2-5 years) to establish a plant in a new environment. Sometimes the plant can't be introduced at all.	(1) (2) (1)

		• Availability of botanical insecticides is confined to a particular season, making import compulsory in off season . • Botanical insecticides decompose very fast and don't have long self life. • Testing of biological materials as botanical insecticides is very difficult and time consuming process and so far, a fraction of flora and fauna has been tested.	
Q.9	a.	Enlist the manufacturing processes of ammonium sulphate and describe the gypsum process.	
		Manufacturing process of ammonium sulphate $(NH_4)_2SO_4$: Ammonium sulphate is manufactured by two processes, i) Gypsum process, ii) By product of coal and steel industries and iii) Neutralization process I. **Gypsum process**: (Raw materials : NH_3, CO_2 and Gypsum) In this process anhydrous ammonia is absorbed in water in a tank and CO_2 is pumped at 5 atmospheres. The resulting Ammonia carbonate is made to react with Gypsum (Calcium dihydarate; $CaSO_4$ $2H_2O$) suspended with water on double decomposition reaction, ammonia sulphate and calcium carbonate are formed. The calcium carbonate being insoluble, precipitated out, the ammonium sulphate solution is filtered out, and crystallized by evaporation. **Reactions**: $NH_3 + H_2O \leftrightharpoons NH_4OH$ + 8.32K.Cal/g.mole $2NH_4OH + CO_2 \rightarrow (NH_4)CO_3 + H_2O$ +22.08 K Cal /g.mole $(NH_4)CO_3 + CaSO_4\ 2H_2O \leftrightharpoons (NH_4)_2SO_4 + CaCO_3 + 2\ H_2O$+ 3.9K Cal/g.mole	(1) (3)
	b.	Classify the insecticides on the basis of chemical nature with suitable examples.	
		Classification of the insecticides on the basis of chemical nature **a. Inorganic** – Ex. arsenates, fluorides compounds. **b. Organic insecticides**. i) Oils and soaps – Petroleum products ii) Plant origin – Nicotine, Geraniol, pyrethrum and Rotenon. iii) Synthetic a.Chlorinated hydrocarbons -DDT, HCH, Heptachlor, aldrin etc. b. Organophosphorus -Malathion, parathion and phosphamidon c. Carbonate insecticides – Carboryl, carbofuran. d. Pyrethoids – Allethrin, permethrin, Deltamethrin. e. Miscellaneous Insecticides – Karathane, DNOC.	(4)
Q.10	a.	Give the occurrence and mode of action of Pyrethrum plant origin insecticide.	
		Occurance and mode of plant originated insecticide Pyrethrum : **Occurrence**: Natural insecticide produced by the daisy-like plant pyrethrum, known as Chrysanthemum cinerariaefolium. The insecticide is concentrated in the flowers of the growing plant. **Mode of action :** Pyrethrum affects the Central Nervous System of insects. Quick knock down action of induction of temporary paralysis. The symptoms follow the typical pattern of nerve poison. Pyrethrum affect central nervous system interfering the Na+ and K+ ionic potential.	(1) (3)

	b.	Define micronutrients. Write the sources of inorganic micronutrient fertilizers.	
		Micronutrients: Micronutrients are the chemical elements necessary only in extremely small amount (usually less than 50 ppm in plants) for growth of plants. **Sources of inorganic micronutrient fertilizers:** **Micronutrients** — **Source of fertilizers** Iron (Fe) — Ferrous sulphate Zinc (Zn) — Zinc sulphate Copper (Cu) — Copper sulphate Mangnese (Mn) — Mangnese sulphate Boron (B) — Borax (Sodium Borate), Boric acid Molybdenum (Mo) — Ammonium molybdate, Sodium molybdate, Calcium molybdate, Molybdenum trioxide	(1) (3)
		SECTION "B"	
Q.11		**Do as directed** 1. The insecticide act was brought in force from 1st August of **1971.** 2. **Behavioural resistance** is a modification in the pest behaviour to avoid the lethal effects of pesticides. 3. Thiram is an example of **sulphur** fungicides. 4. High rates of atrazine are more toxic to maize and sorghum when applied with high rates of **phosphorus** nutrient. 5. **Adjuvant** substance is used in herbicide formulation to modify herbicidal activity or application characteristics. 6. **Pesticide residue** refers to the pesticides that may remain on or in food after they are applied to food crops. 7. **Synergistic effect** is the total effect of a combination of components is greater or more prolonged than the sum of the effects of the two components taken independently. 8. Soils with high in organic matter require relatively large amount of soil-applied herbicide for weed control. (True OR False) : **True**	(8)
Q.12		**Match the pairs**	(8)

	'A'	'B'	
	1. Chelate	a. 2,4-D	
	2. Acaricides	b. BHC	
	3. Complex fertilizer	c. Urea	
	4. Banned insecticide	d. DTPA	
	5. Bordeaux mixture	e. Sulphur	
	6. Photodegradation	f. DAP	
	7. Amide nitrogen	g. Sunlight	
	8. Selective herbicide	h. Millardet	

Answer

1	d	2	e	3	f	4	B
5	h	6	g	7	c	8	a