In spite of all these advantages, biotechnology programme does face uncertainties:-

- The resistance against δ -endotoxin is not ruled out, though it may be slow as compared to insecticides because of continuous exposure of the insect to the toxin.
- Some weeds may introgress an insect resistance gene from related transgenic plants and make them less susceptible to their usual herbivores, thus exhibiting greater reproductive success and may create a weed problem.
- If lepidopteran herbivores were removed from plant species, other insects might experience competitive release and become more common.
- The use of transgenic plants possessing resistance factor in one locality may affect the insect population dynamics in other areas.
- Although Lepidoptera are herbivores as larvae, many are important pollinators of wild species as adults. Therefore, if larval mortality is high, plant communities might also be disrupted by decreasing availability of pollinators. Further, disruption of pollinators and plant communities could occur if the toxin is expressed in plant nectar and pollen. In a recent report, it was found that larvae of the monarch butterfly, *Danaus plexippus*, reared on milkweed leaves dusted with pollen from *Bt* corn, ate less, grew more slowly and suffered high mortality than larvae reared on leaves dusted with untransformed corn pollen or on leaves without pollen. Since corn pollen is dispersed over at least 60 meters by wind and is deposited on other plants near corn fields, it may pose threat to non-target organisms that consume these plants.

The stability of engineered genes such as the *Bt* gene for insect resistance has often been questioned. Constitutive expression of the transgene may exert great selection pressure on the insect population. However, the selection pressure may be minimized by expressing the insecticidal genes only in certain plant parts (tissue specific), or only in response to insect feeding (wound specific) or only at particular growth stages (temporal specific). It has been shown that *pin-2* promoter when attached to the insecticidal gene directs the synthesis of insecticidal proteins in the tissues of transgenic tobacco preferentially consumed by tobacco hornworm larvae. the *pin-2* promoter does not express the insecticidal gene in the leaves, stems, or roots of potato plants until the plants are mechanically wounded. Similarly, if an endotoxin is made to express in the boll tissues of cotton, there would be no selection for resistance in early generation of *Helicoverpa armigera*. Transgenic tobacco plants expressing snowdrop lectin coupled to the *RSsl* promoter which demonstrate phloem-specific expression of this transgene. Similarly, the phloem-specific promoters for use in transgenic rice to control brown plant hopper and other phloem feeders have been isolated.

Future strategies

Resistance of insects can be overcome by plants expressing low levels of toxin. The tissue specific expression of insecticidal genes supplemented by occasional insecticide use would lead to durable resistance. Choice of most appropriate enzyme inhibitors, *viz.* trypsin inhibitors and α-amylase inhibitors to control specific insect pests is important. Recent strategies employed are to produce gene package whose products are targeted to different biochemical and physiological processes within the insect.

Biotechnology has the potential to move farming closer to ecologically sustainable practices, both in developed and developing countries and thus could make a considerable impact on agricultural systems in the future. The strategy to maximize the utility of this approach should involve the use of gene combinations whose products are targeted to different biochemical and physiological processes within the insect. In this way, it is expected to provide a multimechanistic forms of resistance which can be tailored to different crops and prevailing insect pests.

5. BIOTECHNOLOGY AND SEED SCIENCE

SEEDS: THE TALE OF BIO-TECHNOLOGY

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eeds being the basis input for stepping up roductivity, there is a need to continuously centuate seed quality.

me honoured research in these directions, with the lp of bio-technology will enable the production of ality seeds and some relevant issues in this aspect discussed below

1. **Import Technology:** Use of biotechnology in seeds requires import of sophisticated technology equipment and know how. This may be acquired through licensing, purchase, mergers, tie-ups and collaboration with advanced countries and the company thereof.

2. **Protection of Breeders' Rights:** An investor might be reluctant on investing in bio-technological development of new lines because the time period required to reap its financial benefit is long. Moreover, within this tenure the developed new line could be commercially exploited by others. With these apprehensions at the backdrop, it is safer to import planting materials. Proper legislation in the form of bio-patents should be formulated to protect their rights at least for a particular period till the investment is recovered.
3. **Expense of generating new lines:** Involving a new line with the help of genetic engineering is time consuming and expensive. By virtue of tissue culture, the time period for multiplying the lines may be reduced, but the total involvement being high, the end products will be expensive.
4. **Capital Investment:** Application of bio-technology in seeds requires a heavy capital investment in Research and Development. The public sector may plat a key role as funds are not a constraint for it. Institutional funding needs to be done via NABARD CGIAR etc.
5. **Quality Control:** The age old concept of reusing farm saved seeds is gradually receding to the background and seed replacement rate is on an increase. Quality of seeds should be prioritized and bio-technology should play a pivotal role in this aspect.
6. **Emergence of pests:** Tampering the e basic blue print of life i.e. DNA during genetic engineering brings to the fore the possibility of emergence of new pests – it is also brings about certain changes in the micro environment which converts minor pests into major ones. The seeds evolved out of biotechnological methods, too, might have a derogatory effect on the environment.
7. **Farmers participation:** Most of the farmers being small and subsistence ones, capital – intensive biotechnological approach could be disincentive. Unless the farmers participation is maximum, high cost seeds from biotechnology will be a failure. The credit-raising ability of these farmer needs to be increased so that they play an active role in seed production.

The panoply of benefits hidden within the depth of biotechnology can be of prime service to the farming community only if seeds of good quality be produc by it.

6. BIOPESTICIDE

BIOPESTICIDE AS A COMPONENT OF INTEGRATED PEST MANAGEMENT FOR SUSTAINABLE AGRICULTURE FARMING

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What is bio-pesticide?: (1) Chemicals of plant origin, plant parts, their extracts, (2) Microbials as such like virus, bacteria, nematode, fungi, rickkettssia, protozoa, (3) Microbial toxins, (4) Predators and parasites

Plant parts, extracts as biopesticides: (1) Plants which are used as bio-pesticides are neem, mahaneem, karanja, begunia, mahua, custardapple, tulsi, chrysanthemum, ryania, sabadilla, tobacco, thuja, piper, onion, eucalyptus, palmarosa, lemon grass, clove, ginger grass, citronella, castor etc. (2) Either their extracts of parts or oils or oilcakes are used as bio-pesticides.

Neem as bio-pesticide: (1) Mention of neem in Kautilya's Arthasastra during 4th century BC, (2) Susruta during 1000 AD used neem for preparation of medicines, (3) In ancient days neem was used for preparation of ayurvedic, unani and homeopathy medicines, (4) Neem Research in India started in 1962 by Pradhan (neem kernel powder shoed antifeedan tproperty against locust)

Why neem plant product is used as pesticide?: (1) Neem plant parts contain a wide number of limonoids (a group of hpytochemicals) called terpenoids out of which Azadirachtin, Epinimbin, Nimbin, Salanin, Deacetylnimbin, Deacetylsalanin,