The Pharma Innovation Journal 2023; 12(2): 2618-2621

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(2): 2618-2621

www.thepharmajournal.com
Received: 20-12-2022
Accepted: 26-01-2023

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Plant breeding for natural farming

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Abstract
Agrochemicals are harmful to individual because they produce health problems by releasing toxins. Except this soil health also affected because chemicals leached under soil surface mix with water. Mixture of chemicals in each product present that apply on crop plants. So, fruits ultimately absorb residue of these chemicals. Due to this health problems increase day by day and simultaneously environment polluted. To avoid this it is necessary to adopt natural farming. Breeders develop new varieties with improved characters as quality and resistance to disease and insect etc. No chemical application required to prevent growth of pests. These improved varieties play important role to prevent stresses naturally.

Keywords: Leaching, agrochemicals, stress, resistance, variety

Introduction
Day by day increase in population requires more food sources. To increase production rapidly more number of chemicals used in agriculture. But it's not true. Breeders focus on this problem and produce resistance varieties that promote natural farming. Natural farming consist use of organic waste. So, organic plant breeding contributes to organic farming goals such as work in accordance with biological systems and to have positive impact on biodiversity-as organic breeders work with a broader genetic base than conventional breeders (Lina, 2017) [21]. Organic breeding describes natural way of production include hybrid varieties, tissue culture techniques and marker assisted selection. Hybrids consists traits of two different parents with improved quality of each trait. These are heritable and traits fix in variety. Similarly, with marker assisted selection a particular gene identify that code for specific trait. By using this improved varieties developed (Chhetri *et al*., 2013) [7]. Organic plant breeding involve traits associated with superior performance in organic system as insect pest and disease resistance, weed tolerance, adaptation to soil, biologically mediated nutrient availability and tolerance to climatic and environmental stresses (Colley, 2009) [8].
Organic seed and organic varieties that develop by breeders have high degree of resistance to biotic stresses and show competitiveness with weeds. These varieties are tall as compared to non-organic varieties. Various breeding methods used to develop organic varieties as plant introduction, selection, hybridization, biotechnology and population improvement approaches etc. The organic varieties are eco-friendly in nature (Vora, 2018) [33].

How plant breeding promote natural farming
Plant characteristics as appearance of awns in cereals and pubescence on leaves of brassica promote tolerance mechanism in plants against biotic and abiotic stresses. And plant breeders also develop improved varieties as synchronization in legume crops and early maturity varieties etc. show a stress avoidance mechanism. Ultimate aim is to inhibit use of chemicals in agriculture as pesticides. Organic varieties promote natural farming as follows:

Duration period of plant
Early maturing varieties: Minimize climate change effect on farm activities affected by rainfall and drought and day length (Anonymous, 2021) [4]. In the post-rainy season during pod filling in chickpea increase chances of heat and drought stresses. To avoid this risk growing season shorted as 90-120 days in chickpea varieties. ICCV 2 extra early maturity variety of kabuli gram is matures in 85-90 days and resistance to Fusarium wilt and heat tolerance (ICRISAT, 2012) [18]. Early maturity varieties of groundnut escape early leaf spot infection (*Cercospora arachidicola*) and early maturity varieties of wheat escape rust and loose smut infection.

Late sown varieties: Planting of winter wheat varieties too early increase insect pest attack because warm temperature and moisture are favourable for development of fall season diseases as root and crown roots, wheat streak mosaic, barley yellow dwarf, leaf and strip rust. But planting too late gives little time for wheat to establish itself before cold winter temperature sets in (Wegulo, 2016) [35].

Morphological characteristics of plants

Awns in cereal crops: Awns in cereal crops plays importance role in transpiration as well as photosynthesis. Except this, prevent losses due to aphid attack in wheat during field conditions and larvae of khapra insect attack during storage also inhibited due to presence of awns. Awns show anti-insecticidal properties in cereal crops (Acreman, 2008) [1].

Pubescence: Hairy leaves or trichomes, acts as an effective insect deterrent. Collective covering of hairs is known as "pubescence". Hair growth makes difficulty to feed and digestion in insects (Rawe, 2003) [29]. In wheat hairy growth captures water and promotes self-irrigation under drought conditions. Genotypes with deep to medium leaf grooves and dense hairs on edges capture most moisture. It increases tolerant efficiency of wheat against drought and heat stress (Hakeem *et al*., 2021) [15].

Leaf and fruit colour: In vegetables as red cabbage, purple kales and purple beet repellent ability and less infected by caterpillars and aphids. Cabbage looper caterpillar with its pale green colour is perfectly camouflaged on green leaf and therefore almost invisible but stands out like a becon when it's on purple leaf. Because colourful vegetables are less attractive to insects than green colour (Hodgson, 2018) [17].

Floral structure: In sorghum tightly glume spikelets shows resistant to bugs and compact and tightly wrapped whorl leaves around stem shows show resistance to plant hopper (*Perigrinus maids*) (Kalaisekar and Patil, 2017) [19].

Physico-chemical characteristics of plants

Glucosinolates: Glucosinolates contain non-volatile and sulphur-containg plant metabolites. When insect herbivores feed on *Brassica* sp. (Tripathi and Mishra, 2007) [31]. Glucosinolates release toxins acts as a natural repellent and prevent growth of aphid (*Lipophis erysimi*) (Ahuja, 2010) [2].

β-expansion proteins: Maize is susceptible to salt stress because it influences seed germination, suppress leaf initiation and internodes growth. Due to salt stress shoot growth reduced and β-expansion proteins positively correlate with salt stress (Farooq *et al*., 2015) [12]. To avoid these problems makes maize varieties that are resistance to salt stress by up-regulation of β-expansion proteins (Geilfus *et al*., 2010) [13].

DIMBOA: DIMBOA is 2,4-dihdoxy-7-methoxy-1,4-benzoxazin-3-one. In maize it present in midwhorl leaf tissue infects leaf feeding ratings by European corn borers (ECB). Recurrent selection maize breeding technique was effective in increasing DIMBOA content in leaf tissues and thus, in increasing leaf-feeding resistance (Guthrie *et al*., 1986) [14].

Carotenoids and phenolic compounds: Yellow-orange maize contains bioactive phytochemical as carotenoids, phenolic compounds, tocopherols and phytic acid. Except carotenoids other compounds considered as non-nutritive components. Among these compounds phytic acid inhibit absorption of iron, zinc, calcium and magnesium and manganese. Similarly tannin content with phytic acid responsible for suppression of Striga growth in maize (Elemosho *et al*., 2020) [10].

Hybridization

Crossing between two unrelated parental plants varieties, species or genera produce hybrid varieties that aids in transfer of traits from one plant species to another. In cotton *Gossypium arboreum* species show resistance to cotton leaf curl disease (CLCuD) but *G. hirustum* susceptible to this. To avoid this cross between *G. arboreum* and *G. hirustum* made and hybrid varieties tolerant to leaf curl diseases (Naqvi *et al*., 2017) [24]. Rust resistance varieties developed in wheat by crossing between *Triticum durum* and *Triticum aestivum*. Here, *Triticum durum* is donor parent of rust resistance plants. Similarly, Bacterial leaf blight (BLB) is most common disease of rice responsible for higher yield loss. To overcome this problem two rice varieties TGMS line and restorer line bred using broad-spectrum resistance gene *Xa23* through marker assisted selection (MAS) combined with phenotypic selection. Hybrids exhibited enhanced BLB resistance with excellent yield performance (Wang *et al*., 2020) [34].

Wild relatives: World relatives provide genetic diversity that may not available in cultivated species. With novel genetic diversity wild relatives acts as building block and breeder used these relatives to construct improved varieties (Volk *et al*., 2020) [32]. Solanum demissum wild relative of potato show resistance to late blight of potato caused by Phytophthora infestans. On crossing with cultivated species resistances gene transfer into cultivated species (Killian *et al*., 2010) [20]. Similarly, wild relative of wheat as *Aegilopis tauschii* show resistance to stem rust of wheat caused by Puccinia graminis. Resistances genes in wheat cultivated species transfer from this wild species (Dempewolf *et al*., 2017) [9]. Grassy stunt virus resistance from *Oryza nivara* to *Oryza sativa* and late blight resistance from *Solanum demissum* to *Solanum tuberosum*. *Avena fatua* wild relative of oats effective source of powdery mildew resistance genes and good environmental adaptability. It is also a good source of barley yellow dwarf virus (BYDV) resistance (Okan *et al*., 2021) [26]. Teosinate wild relative of maize with toughness in leaves acts as physical barrier to prevent fall armyworm (FAW) (*Spodoptera frugipedra*) and leaf hopper (*Dalbulus maidis*) attack. It contains *wip1, RP1 and chitinase* genes that tolerant FAW. It is good source of biotic stress resistance used for hybridization with cultivated species (Mammadov *et al*., 2018) [22]. Wild relatives of Sorghum used to develop Striga resistance varieties as *Sorghum versicolor* and *Sorghum drummondii* (Belay, 2018) [6].

Tissue culture techniques

Virus-free plants: Meristem culture used for virus-free plant development due to continuous cell division occurs in meristem that inhibits virus growth. By active cell division differentiation of vascular tissues reduced (Quiroz *et al*., 2017) [28]. In onion two species *Allium sativum* and *Allium tuncelianum* meristem and shoot tip medium used to produce virus-free plants. Onion yellow dwarf virus (OYDV) and leek

yellow stripe virus (LYSV) resistance plants develop in onion using shoot tip culture (Taskin *et al*., 2013) [30]. Cymbidium mosaic virus (CymMV) is orchid virus found in *Cymbidium* sp. was propagated by using MS medium. *Cymbidium aloifolium* plant becomes resistant to CymMV (Pradhan *et al*., 2016) [27].

Genetic engineering

Genetic engineering is the artificial manipulation, modification and recombination of DNA or other nucleic acid to modify organisms. It is used to produce disease resistant, insect resistance and quality trait improvement (Anonymous, 2022) [5]. *Bt* cotton effectively controls a lepidopteran pests and has become a corn stone in overall integrated pest management (IPM) due to *cry* proteins from *Bt* genes of *Bacillus thruigenensis* is a soil bacterium cause alkalinity in intestine of insect by crystal formation that inhibit attack of pink bollworm on cotton bolls (Naranjo, 2010) [25]. Stem rust of wheat suppress by SuSr-D1 gene identified in 'Canthatch' cultivar of wheat. The Med15 encodes SuSr-D1 gene that regulates expression of protein-coding genes (Hiebert *et al*., 2020) [16]. Genome editing technology including CRISPR-Cas9 helps for improving CCN (Cereal cyst nematode) resistance in wheat and barley (Ali *et al*., 2019) [3].

Marker-Assisted Selection (MAS)

R genes (race-specific genes) function from seedling to adult stages but lack of durability and encode immune receptors of the nucleotide binding leucine rich repeat (NB-LRR) class. APR (adult plant resistance) genes work at adult stage only and they show a long lasting durability. Two APR (adult plant resistance) genes Lr34 and Yr36 have been cloned from wheat and their products are an ABC transporter and protein kinase, respectively. The effect of both R and APR genes combined in one plant variety to increase horizontal resistance effect (Ellis, *et al*., 2014) [11]. *Mi* locus of tomato is resistance to root knot nematode (*Meloidogyne* sp.). It is transferred into cultivated species of tomato (*Lycopersicon esculentum*) from wild species (*Lycopersicon peruvianum*). Tomato DNA spanning the locus was isolated as bacterial artificial chromosome clones and 52 kb of contiguous DNA was sequenced. Three open reading frames were identified with similarity to cloned plant nematode resistance *Mi* genes (Milligan *et al*., 1998) [23].

Conclusion

Organic plant breeding is a multidisciplinary approach that avoids chemical use and develops varieties that are suitable for organic farming. It is a non-chemical agriculture farming approach that makes agro-ecological balance by reducing cost of cultivation by inhibiting use of agrochemicals. Eco-friendly organic varieties inhibit depletion of resources and promote use of biological inputs as organic manures, botanical pesticides as neem, whey etc. and also allow the multiplication of friend insects as lady bird beetle that feed on harmful insects. Ultimately these products improve soil physic-chemical conditions, increase soil fertility and make environment pollution free. Due to chemical use avoidance growth of microflora increase and soil conditions improve and ground water becomes chemical free.

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