SAFE WHEAT PROTECTION BY OBLIGATE PRESENCE OF Lr 29 GENE

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Abstract: Product of Lr 29 gene was still founded to be only one that accelerated degraded all of applied pesticides based on dithiocarbamate, phtalamide, neonicotnoide, glyphosate and bentazone containing sulfur or phosphorus. Shortened currency time facilitated their application in optimal time for targets reduction and safe wheat production in regions with short grain filling periods. Suggestion for its obligate presence in assortment there supported even lowest founded number of Lr genes groups enough for durable resistance to leaf rust cause handling as well as decreased amount of sulfur in gluten.

Key words: wheat protection, pesticide, Lr gene

Introduction

Recognizing the similarity between the fungi cell wall that structured glycoproteins containing sulfur and phosphorus (Harder and Chong, 1984) to protein chains with external disulphide linkages initiated was relative contemporary, confirmation of primary function of genes responsible for race specific resistance to leaf rust cause *Puccinia triticina to* degrade gluten formed in leaves at continual dry conditions (Jerković et al., 2013). Simultaneous, explained was hypersensitive reaction trough consequential acids and its influence on chlorophyll while before undefined prolonged latency period or time between infection and fructification become logical consequence of adequacies between genes from parasite and host confirming initial gene to gene theory (Flour, 1971). The size of these genes (Huang et al., 2003) and overweight of products to pass trough wheat cell membrane explained their absence in seed and facilitated gluten formation there. Across most hydrolytic stable ones, achieved was higher protein content in Lr near isogenic lines (Nils) up ground seedlings parts and such also reached lower gliadin share in seed gluten without any consequences on baking quality (Masson et al., 1986). The discovery of the difference between specific and nonspecific Lr genes in expression at seedling stage across infection efficiency explained limited complementary effects (Jerković and Putnik, 2004). Related was of nonspecific genes function to degrade starch facilitating the accelerated growth of further organs while simultaneous causing the water deficit below (Jerković et al., 2013b).

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Also, such was to conditions related previous divide of Lr genes as responsible for seedling or adult resistance (Dyck, 1991). Further were focused interactions between specific Lr genes and pesticides containing sulfur or phosphorus while until nowadays, those between Lr genes and dithiocarbamate, phtalamide, neonicotinoides or glyphosate were investigated (Jerković and Prijić, 2012; Jerković et al., 2014, Jerković et al., 2015). The effects were wide different but exclusive influence of specific Lr genes on accelerated liberation of mentioned elements was confirmed. Their linkages strength was also crucial for further residua destiny according to correlated time necessary for their degradation (Osborne and Stain, 2009; Škerbot, 2011). Also, if external to rings were grouped three Fluorine like almost double heavier chlorine in phtalamide, accelerated relist was also become expected by appearance in field 2014th. Than, fast yellowing of the leaves by sequenced application of four mentioned structured plus fluorine containing pesticide was recognized for the difference to no one when treatment by dithiocarbamate or glyphosate was performed even at beginning of June on same wheat assortment with specific Lr genes. There was any visual effect of pesticides on genotypes containing only nonspecific Lr genes with exception of glyphosate when per oxidation was recognized by whitening of the spikes (Jerković et al., 2014a). The wheat genotypes tolerant to glyphosate were evaluated (Gordon et al., 2004), as well as interactions with *Puccinia spp*. (Anderson and Kolmer, 2005; Feng et al., 2004). The main problem of wheat protection by pesticides in regions with continental climate become luck of water during grain filling when pest causers most abundant appeared. By vice versed conditions in that period annulated was effect of relative higher temperatures equalizing time for pesticides degradation in all regions. Significant appearance of prevalent pathogens or weeds in regions with prolonged grain filling was stable during the vegetation for the difference of aforementioned. By forecasting model involving of the facultative and obligate parasites antagonism also, determined was time for sustainable protection at the beginning of June economical throw reduction of *Puccinia triticina* at susceptible varieties, two weeks before the predicted time when leaf grain area mostly disappeared (Jerković and Jevtić, 2012; Jerković et al., 2013a). The problem of no adequate systemic fungicides and inseticides according to residua degradation and optimal time for application at wheat assortment was not generally solved. Same problem was with adequate structured herbicides as bentazone and such as glyphosate most likely also not reducing *Purenophora tritici repentis* (Sharma et al., 1989), not aggressive most efficient leaf rust antagonist for the difference of *Septoria tritici*. Such, by additional investigation of Lr genes in Nils effects to bentazone and glyphosate aimed was to choose those useful in other two above mentioned directions beside parasite reduction and in regions with shortened grain filling on around 40 days facilitate the occasional optimal protection by pesticides.

Material and method

Specific Lr genes introduced in Thatcher background (Lr NIL) were selected as different across influence on gluten (Lr 1), dithiocarbamate (Lr 16) or neonicotinoides (Lr 29) accelerated degradation or no such effect (Lr 2a and Lr 24) while nonspecific ones representatives were Lr 22b and Lr 14a. Lines were grown in the glasshouse at

average air temperature around 20°C at day/night regime 10/14 h. Lr NILs were simultaneous sown same ordered in pots (30x25x15cm) while density was approximately one plant per 50 mm^2. Daily watering of the soil was stopped two days before 0,05 mg/m2 glyphosate based herbicide in water suspension was applied on selected plants of each NIL with near equal lengths six days after germinating. In sequential trial approximately 50 seeds were sown random in pots (5x5x7cm) and treated with 0,4ml/m^2 herbicide based on bentazone equaly. NILs were halved by cover before the treatment. For further calculations criterion was that stems of NIL sample could to be different in the interval of 5 mm. At least five plants from twenty viable in each of the replications had to be in representative sample for calculation of average part lengths of the NILs. Of treated and control NIL growth potential was equalized across formula: (average first and second leaf lengths sum of treated or control NIL with lower average stem length) x average higher stem length: average lower stem length + average higher stem length while growth difference presented in percents (average up ground length of treated plant parts : average up ground length of treated plant parts x 100).

Results and discussion

The only genes discovered to be efficient for accelerated degradation of all pesticides was Lr 29. When focused were herbicides the effect when some of specific Lr genes were present was vice verse than in previous studies of fungicides and insecticides. By different effects on NILs with nonspecific gens Lr 22b and Lr 14a proved was contact effect of bentazone only at treated first leaf as well enzyme of Lr 22b as amylase as was previous stated (Jerković et al., 2013). The appearance of increased growth of second leaf was linked to reserves of starch from seed and was not expected in adult stage. The difference between effects of glyphosate and bentazone was linked to influence on ATP synthesis of first and chlorophyll illumination of other one. Gluten degradation results indicated intermediate hydrolytic stability of Lr 29 when compared to Lr 1 or specially Lr 15 and opposite Lr 24 one. The luck of Lr 24 effect previous related to its hydrolytic non stability by these on glyphosate and bentazone proved another difference based on no possibility to approach the targeted element when some units were external linked beside while the cleaved linkage strength was not the problem as was for hydrolytic stable ones (Tab. 1).

Tabela 1. Uticaj pesticida na rast sejanaca izogenih linija sa različitim Lr genima u procentima prema kontroli

Table 1. The influence of pesticides on growth of nearisogenic lines different by Lr genes in percents to control

Aktivna materija pesticida Pesticide active base	Karenca u danima Currency time in days	Doza ml ili mgr/m^2 Dose Ml or mgr/m^2	Lr 1	Lr 2a	Lr 16	Lr 24	Lr 29	Contolna Lr 22b NIL Control Lr 22b NIL
Ditihocarbamate	14	0,4	96	93	80		91	98
Phtalamide	14	0,4	99	95	97		83	99
Thiametoxam	21	0,1	102	102	101	102	98	102
Thiacloprid	21	0,1	103	104	102	100	97	100
Glyphosate	-	0,05	99	84	85	97	88	82
Bentazone	63	0,4	99	91	98	100	99	113 Lr14a 90

The genes like were Lr 2a and Lr 9 never find to be such effective had to be similar to Lr 24 by two of characters but could not approach to the targeted element positioned in chain or its end if some elements were directly linked as were in glyphosate or bentazone also. For genes like was Lr 24 in focused regions its never for sure that will be enough wide active except around the parasite and such they become useless even for degradation of glyphosate. The realized influence of specific Lr genes from all other groups on bentazone was expected because of relative less limited approach ability and weaker linked sulfur to nitrogen than was to carbon. Its predictable that genes like was Lr 29 from all above reasons best choice for stable presence in the varieties, have not to be recognizable by interactions with parasite in future while the interaction with neonicotinoides could facilitate their identification. At first, suggested was necessarily presence of Lr 20 and Lr 29 to ensure effect on residua containing sulfur when nearby nitrogene or chlorine was relisted because of questionable adequacy of Lr 29 for former linkage strength (Jerkovic et al., 2015). Discovery of its product influence on even stronger phosphorus linkages in residua (Jerkovic et al., 2014) overcome such dilemma while its approach ability was considered not to be limiting factor as was appeared to be for Lr 20. Such, even more dry conditions could be used for their identification trough decreased effect of Lr 20 product instead of molecular markers. Increased level of the resistance by accumulation of specific Lr genes suggested by pyramiding strategy also recognized as solution to improve durability of resistance according to novel investigations become also risky respecting of the resistance genes limited diversity especially because the cleaved linkage strength and hydrolytic stability seemed to be correlated. However, by lines containing the specific Lr genes in same background, assuming the all tests speculated was existence of nine mine groups, still making room

for one of to sacrifice according to future parasite reduction by its resistance overcome across adequate parasite genes elimination. Such, sustainable seed production in semiarid regions with continental climate, considering at least of three different Lr genes groups simultaneous separated presence in assortment could be performed throw permanent possibility for replacement of overcome ones. Even based on three independent characters it was not possible that 69 until nowadays identified Lr genes (Huerta-Espino et al., 2011) all be significantly different according to products recognized characters. The main problem of different genes presence at same chromosome like were Lr 19, Lr 29 and Lr 34 on 7D (Mc Intosh et al., 1995) and such no conventional breeding possibility for their accumulation in order to enhance the resistance level could be solved by finding the same or similar acting different located ones.

Conclusion

By involving of genes like was Lr 29 in all varieties of regional assortment throw accelerated degradation of investigated pesticides adequate for et once multi pests reduction could be facilitated their application in optimal time when decided to be economical by forecasting models and achieved the safe production of grain and other plant parts, other words, residua free. By obligate presence of genes from group described by characters of Lr 29, it was not expected significant decrease of possibility for durable resistance to leaf rust causer simultaneous handling also on economical level meaning that treatments against have not to be rentable at least five years after variety application as well as share of gliadine in gluten had to be decreased. However, it was suggested that genotypes with genes from group characterized by Lr 29, have to be favor for approval and widespread in production. Introduction by genetic engineering at that instance even by States institutions was also one of solutions.

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