From the National Research Centre, Dokki, Cairo (Egypt)

Changes in the nutrient components of the grains yielded from spraying wheat plants with a mixture of 2,4-D and dicamba

S. M. Hegazi, R. R. El-Masry and F. I. El-Bastawesy

With 2 tables

(Received July 2, 1974)

The most fascinating researches with growth regulating stubstances such as 2,4-D, dicamba and NAA, in the field of agriculture had been in their contribution for getting increased yields in crop plants. In recent years some evidence has been demonstrated that such treatments not only influenced the plant growth and consequently its yields but also the chemical composition of the treated plants as well as the seeds produced (1, 2, 3, 4). It was reported that due to the more active growth of vegetative parts of wheat treated with 2,4-D, grain forming was improved and the protein content of the grain was increased.

A relation between the protein content of the grains and the stored carbohydrate was reported (5, 6, 7, 8). The increase in the amount of protein was accompanied with a considerable reduction in the carbohydrate reserves.

The purpose of the present investigation was aimed to study the chemical composition of the wheat grains obtained after spraying the wheat plants with 2,4-D and dicamba mixture in an attempt to determine the extent of their economic in agricultural application.

Experimental

Materials and methods

Sampling

Wheat (*Triticum vulgare*, variety Giza 155) was grown in the experimental farm of the National Research Centre at Shalakan in the growing season of 1972–1973. The wheat plants (4–5 leaves) were sprayed with a mixture of 2,4-D (2,4-dichlorophenoxy acetic acid) and dicamba (2,methoxy,3,6-dichloro benzoic acid) 10–1 v/v. at a rate of one liter per acre. At maturity wheat grains were collected, and finely ground then subjected to chemical analysis.

Methods of analysis

The samples were analysed for moisture and protein, using the usual standard methods (A.O.A.C. 1965).

Determination of amino acids

Samples were hydrolyzed with 6 N HCl for 22 hrs. at 110° C according to *Khan* and *Baker* method (9). The HCl was evaporated off under vacuum. Portions of the hydrolysates were spotted on the Whatman filter paper No. 1, and two

dimensional ascending chromatograms were prepared using the buffered method of *Levy* and *Chung* (10). Cystine and methionine were estimated after the performic treatment (11). The located amino acids were determined colorimetrically as reported in a previous work (12).

Determination of total sugars and starch content

Total sugars and the starch content were determined by the anthrone reagent after the extraction according to the method of *Clegg* (13).

Results and discussion

Spraying of wheat plants (4, 5 leaves) with a mixture of 2,4-D and dicamba (10–1 v/v) at a rate of one liter per acre resulted a marked increase in the grain yield (66.38 %). Analysis of sugars and starch contents of the grains and the controls (table 1) showed a marked increase in the starch content of the controls compared with their amounts in the treated grains.

Table 1. Comparison of the total sugars and the starch content of the wheat grains obtained after the spraying treatment and the controls.

	Total sugars %	Starch content %
Grains of treated wheat	2.01	68.40
Grains of controls	2.13	72.63

It is seen that no differences were observed in the amounts of sugars in both the treated grains and the controls as shown in the table. Such observations agree quite well with previously reported ones by *Pande* (5), and *Bhardwaj* (2). They found that pretreating of wheat grains with the growth regulating substances resulted a depletion in the amount of carbohydrate fractions such as starch, reducing sugars and inverted sugar. Other investigators (5, 6, 7, 8) suggested that the decrease in both the sugars and the starch reserves after the 2,4-D application may be explained that a portion of the carbohydrate is utilized in protein synthesis. They pointed that it is appeared that simple sugars could not have been utilized in the formation of structural constituent but they might well have been used in the formation of the increased amount of nitrogen.

The data presented in table 2 show that the protein nitrogen content of the wheat grains of the treated plants was increased markedly. It is appeared that the herbicides have exerted effects on the constituents of the grains and may induce accumulation of nitrogenous components in the yielded grains. Such findings shown herein are in close agreement with those found by *Bhardwaj* (2), *Smith* et al. (6), *Huffaker* et al. (4), and *Erickson* et al. (14). They reported a marked increase in the protein content of the grains after the 2,4-D treatment, and suggested that the carbohydrate metabolism is seriously disturbed and that a portion of the carbohydrate is utilized in the protein synthesis.

A glance to table 2 shows that there was slight variation in the amounts of the amino acid components calculated as mg/g N of both the control and the treated grains. Differences were observed in the amounts of

aspartic acid, glutamic acid, glycine, alanine and tyrosine which were present in relatively larger amounts in the control than that of the treated grains. Such changes had been previously reported by *Livingston* (13), and *Fults* and *Payne* (14) during the application of 2,4-D to sugar beets. Lower values for glutamine, alanine and tyrosine were noted in the treated plants than in the controls.

Table 2. Effect of 2,4-D and dicamba mixture on the protein and amino acid contents of the treated wheat grains and the controls

Amino acid	Control grains mg/g nitrogen	Treated wheat grains mg/g nitrogen
Aspartic acid	738	671
Glutamic acid	1923	1880
Serine	453	455
Glycine	435	408
Threonine	192	193
Alanine	378	368
Tyrosine	187	180
Valine	308	322
Leucine + isoleucine	598	631
Phenylalanine	290	297
Lysine	172	176
Arginine	271	297
Tryptophan	70	72
Proline	154	178
Cystine	151	148
Methionine	96	100
Histidine	147	145
Total protein nitrogen %	9.80	12.85

The proportions of serine, threonine, histidine, tryptophan, cystine and methionine were very similar. An apparent increase in the levels of valine, leucine and isoleucine, arginine, phenylalanine, and lysine was observed in the treated grains (table 2).

From the point of view of human nutrition wheat is deficient in lysine, tryptophan and methionine and the possibility of increasing their amounts will be useful in improving the wheat proteins.

In general the interesting feature of our results obtained is the high yield of grains accompanied with good quality of protein and amino acid contents which were superior in the treated wheat plants than the controls.

Summary

Spraying wheat plants with a mixture of 2,4-D and dicamba (10–1 v/v) was applied. Chemical analysis of the yielded grains showed a relatively high protein content compared with the controls, accompanied with a considerable reduction in both the starch and sugar reserves. Protein hydrolysates of the grains and the controls revealed the presence of the same amino acids with slight differences in their amounts.

References

1. *El-Masry, R. R.*, Ph. D. Thesis, Cairo Univ. 1970. – 2. *Bhardwaj, S. N.*, J. Ind. Bot. Soc. **41**, 326 (1962). – 3. *Filippenko, I. A., L. I. Pavlova*, Fiziol. Rast **11**, 603 (1964). – 4. *Huffaker, R. C., M. D. Miller, K. G. Baghatt, F. L. Smith, C. W. Schaller*, Crop Sci. **7**, 17 (1967). – 5. *Pande, H. K.*, Agra. Univ. J. Res. Sci. **3**, 242 (1954). – 6. *Smith, F. G., C. L. Hamner, R. F. Carlson*, Plant Physiol. **22**, 58 (1947). – 7. *Rasmussen, L. W.*, Notiz Mallattie Planto. **19**, 6 (1949). – 8. *Sell, H. M., R. W. Luecke, B. M. Taylor, C. L. Hamner*, Plant. Physiol. **24**, 295 (1949). – 9. *Khan, N. A., B. E. Baker*, J. Agric. Food Chem. **3**, 853 (1955). – 10. *Levy, A. L., D. Chung*, Anal. Chem. **25**, 396 (1953). – 11. *Jamalian, J., P. L. Pellet*, J. Sci. Food Agric. **19**, 378 (1968). – 12. *Hegazi, S. M., S. A. Salem*, J. Sci. Food Agric. **25**, 497 (1972). – 13. *Clegg, K. M.*, J. Sci. Food Agric. **7**, 40 (1956). – 14. *Erickson, L. C., C. I. Seely, K. H. Klages*, J. Amer. Soc. Agron. **40**, 659 (1948). – 15. *Livingston, C., M. G. Payne, J. Fults*, Bot. Gaz. **116**, 148 (1954). – 16. *Fults, J. L., M. G. Payne*, Bot. Gaz. **118**, 130 (1956).

Authors' address:

National Research Center, Dokki, Cairo (Egypt)