Acta Ciencia Indica, Vol. XLIV C, No. 4, 135 (2018)

EFFECTS OF PESTICIDES ON CHANGES IN REDUCING SUGAR, STARCH AND SOLUBLE PROTEIN DURING MATURATION OF DIFFERENT VARIETIES OF *RAGI*

P.K. MISRA

Ex-Department of Chemistry, Ravenshaw College, Cuttack-753003 (Odisha)

RECEIVED : 14 December, 2018

Two pesticides, phorate 10 G and Furdan 3 G were applied on different varieties of Ragi. The quantity or reducing sugar, starch and total soluble protein in cars were determined at different intervals from panicle initiation to harvesting. In most cases, the application of pesticides enhanced the nutrient contents very slightly. Furadan 3 G raised the content of reducing sugar, whereas phorate 10 G promoted the production of starch and protein. Among the three varieties at harvest HP 1529 was highest in reducing sugar and UP 262 in starch whereas Sonalika was highest in protein. On days 0 (panicle installation), 5, 10, 15 and 34 days after flowering (DAF) reducing sugar was found to be positively correlated on days 20, 27 and 41 DAF negatively correlated with starch and protein.

INTRODUCTION

The effects of pesticides on biochemical processes, activity of enzymes and nutrient contents of crops have recently drawn attention. The effects of several pesticides on the photosynthesis and activity of granulum bound starch synthetase of barley and wheat have been investigated (Toriu *et al.*, 1983). Application of pesticides has been found to change the carbohydrate content of *Vicia foba* (Prensser *et al.*, 1984) and maioze (Rajoo, 1981). Changes in protein due to the application of pesticides has also been observed in rice grain (Petibskaya, 1985) and wheat grain (Martin *et al.*, 1986). The present investigation was undertaken to study the effects of Phorate 10 G and Furadan 3 G on the production of reducing sugar, starch and protein in three wheat varieties.

MATERIALS AND METHODS

Seeds of three Ragi varities T_{20}, Sodangi (6), and C09 were sown in a randomized block design with three replications at the Botany Department, Ravenshaw College, Jan 2018 in plot sizes of 8 × 5 m. Furadan 3 G (0.5 kg a.i.ha^{1}) and Phorate 10 G (1kg a.i. ha^{-1}) were applied 40 days after transplanting. Panicles were collected from panicle initiation (0) to 20 DAF at 5 day intervals and from 20 DAF to harvesting stage (41 DAF) at 7 day intervals.

Collected panicles were perfectly dried under the sun and seeds were separated from spikelets, dried in an over at 45°C and grinded finely by grinding machine (60 mesh sieve).

Extraction and estimation of reducing sugar and starch were done following the procedure as described by Yoshida *et al.* (1972) using Backman (model DU-6) UV/VIS

Spectrophotometer. Total soluble protein was estimated by the colorimetric method of Lowery *et al.*, (1951) as modified by Hartree (1972).

Results and discussion

Reducing sugar content

It is revealed from Table 1 that all the varieties exhibited significant offsets on the production of reducing sugar during the growth period. But the production rate did not follow a continuous increasing trend, rather it followed a zig-zag path. Maximum sugar was found on 20th day in T20 27th day in Sodangi (6) and 41st day in CO9. Application of pesticides increased the reducing sugar content and the change was found to be significant. Furadan 3 G promoted higher production of sugar thanphorate 10 G at harvest (Table 1). So far, the effects of the interaction between varieties and pesticides were concerned, the combination of UP-262 × Furadan 3 G produced maximum sugar at harvest. On an average, the varieties combined with the pesticides promoted higher sugar production.

Table 1. Effects of pesticides on Reducing Sugar in course of maturation of ragi

Treatments Varieties	A. Reducing Sugar (%)							
	Days after flowering							
	0	5	10	15	20	27	34	41
T20	3.01	3.06	4.16	4.54	4.83	4.38	4.06	3.45
Sodangi (6)	2.74	2.69	3.14	4.36	4.54	4.56	3.84	4.05
Co9	3.05	2.79	4.04	4.43	4.64	3.92	4.39	4.86
SEm±	0.104	0.104	0.113	0.112	0.116	1.135	0.094	0.206
CD at 5%	0.309	0.309	0.335	0.332	0.338	0.406	0.288	0.615
Pesticides								
Control	2.13	2.15	3.29	4.334	4.55	4.63	3.62	3.99
Phorate-10G(Kg.al.ha^{-1})	3.35	3.28	4.76	4.882	4.59	4.55	3.694	3.69
Furadan-3G(kg.al.ha^{-1})	3.36	3.04	3.68	4.051	4.83	4.26	4.885	4.75
SEm±	0.102	0.108	0.113	0.114	0.114	0.138	0.096	0.206
CD at 5%	0.309	0.309	0.335	0.334	0.338	0.406	0.286	0.615
Interaction								
T20 × Control	1.79	1.98	3.28	4.46	4.08	3.63	3.28	2.79
Sodangi(6) × Control	2.43	2.44	2.64	4.75	5.09	5.29	3.84	3.54
Co9 × Control	2.16	2.05	3.73	3.84	4.55	3.17	3.73	5.36
T20 × Phorate-10G	3.09	3.36	4.46	4.65	5.36	5.09	3.36	3.06
Sodangi(6)×Phorate-10G	2.88	3.06	5.09	4.83	4.19	5.09	3.15	3.18
C09 × Phorate – 10G	3.26	3.45	4.74	5.18	4.19	3.64	4.56	4.83
T20 × Furadan – 3G	3.45	3.99	4.74	4.46	5.06	4.46	5.54	4.46
Sodangi × Furadan – 3G	2.88	2.54	2.64	3.45	4.38	3.46	4.44	5.48
Co9 × Furadan – 3G	3.73	2.64	3.64	4.28	5.19	4.94	4.64	4.35
SEm±	0.179	0.179	0.195	0.194	0.198	0.236	1.166	0.356
CD at 5%	0.536	0.535	0.578	0.575	0.586	0.706	0.495	1.066

Table 2. Effects of pesticides on Reducing Sugar in course of maturation of ragi

Treatments	B. Starch (%)

Varieties	Days after flowering							
	0	**5**	**10**	**15**	**20**	**27**	**34**	**41**
T20	15.98	11.95	21.28	36.59	48.66	56.05	59.98	63.85
Sodangi (6)	14.15	10.98	25.96	36.35	49.08	57.26	62.79	64.34
Co9	16.64	12.73	25.46	39.53	47.54	52.42	59.94	63.76
SEm±	0.099	0.095	0.124	0.544	0.159	0.113	0.195	0.123
CD at 5%	0.293	0.284	0.371	1.629	0.476	0.335	0.586	0.365
Pesticides								
Control	14.76	11.56	21.28	38.39	47.44	53.65	59.78	63.00
Phorate-10G(Kg.al.ha^{-1})	16.34	12.49	25.68	38.68	50.34	56.94	62.38	65.16
Furadan-3G(kg.al.ha^{-1})	15.782	11.69	25.79	35.38	47.44	55.14	60.48	63.85
SEm±	0.098	0.095	0.124	0.545	0.154	0.113	0.194	0.123
CD at 5%	0.296	0.284	0.379	1.629	0.476	0.335	0.585	0.364
Interaction								
T20 × Control	14.33	12.14	16.76	33.99	46.74	53.46	57.95	63.09
Sodangi(6) × Control	13.34	10.74	21.16	38.43	44.16	52.09	60.76	64.23
Co9 × Control	16.64	11.83	25.88	42.74	51.49	55.59	60.55	61.68
T20 × Phorate-10G	17.95	12.86	23.09	40.95	50.45	57.86	59.75	64.28
Sodangi(6) ×Phorate-10G	14.65	12.39	27.45	36.15	55.65	60.88	64.15	65.26
C09 × Phorate – 10G	16.35	12.06	26.53	38.95	44.95	51.98	63.18	65.89
T20 × Furadan – 3G	15.73	10/83	23.86	34.89	48.84	56.78	62.29	64.15
Sodangi × Furadan – 3G	14.16	9.94	29.36	34.89	47.36	58.85	63.18	63.68
Co9 × Furadan – 3G	16.94	14.39	23.96	36.86	46.164	49.75	56.04	63.69
SEm±	0.179	0.163	0.215	0.938	0.275	0.195	0.338	0.214
CD at 5%	0.519	0.486	0.614	2.819	0.825	0.583	1.016	0.634

Starch content

The effects of varieties on the content of starch were almost similar (Table 2). All of them initially exhibited a reduction in starch production on 5 DAF followed by continuous significant increase till harvest. Application of pesticides had no remarkable effect. However, it was not detrimental as well (Table 2). It is observed from Table 2 that combinations of varieties and pesticides bestowed a little effect in promoting starch formation in comparison to the combination of Varieties x control. The interactions between Varieties x Phorate 10 G exhibited better results than other interactions. Starch was positively correlated with sugar on 0, 5, 10, 15 and 34 DAF (Table 4).

Protein content

It is revealed from Table 3 that production of protein was significantly increased during the growth period of all the varieties. At harvest, the content of protein was almost same. Application of pesticides on protein remarkably during the growth period. But the combinations of varieties x pesticides increased very small amount of protein into the grain during development although this increment was not consistent. Protein was found to be in positive correlation with sugar on 0, 5, 10, 15 and 34 DAF and with starch on 0, 5, 20, 27, 34

and 41 DAF. A significant positive correlation also existed with starch on 0 and 41 DAF at 5% level (Table 4).

Table 3. Effects of pesticides on Total Soluble Protein in course of maturation of ragi

Treatments Varieties	A. Total Soluble Protein (%)							
	Days after flowering							
	0	5	10	15	20	27	34	41
T20	11.08	11.96	12.64	13.54	13.94	14.19	14.43	14.59
Sodangi (6)	9.86	11.18	11.75	12.68	13.75	14.14	14.28	14.49
Co9	11.06	11.79	12.23	12.63	13.44	14.06	14.34	14.48
SEm±	0.019	0.029	0.036	0.016	0.022	0.016	0.014	0.014
CD at 5%	0.048	0.089	0.106	0.045	0.058	0.046	0.034	0.035
Pesticides								
Control	10.05	11.25	12.09	12.66	13.44	13.96	14.26	14.35
Phorate-10G(Kg.al.ha^{-1})	11.05	11.76	12.39	13.24	13.73	14.23	14.49	11.63
Furadan-3G(kg.al.ha^{-1})	10.93	11.89	12.26	12.94	13.73	14.18	14.36	14.46
SEm±	0.08	0.029	0.036	0.016	0.026	0.018	0.014	0.014
CD at 5%	0.049	0.089	0.106	0.046	0.058	0.048	0.034	0.035
Interaction								
T20 × Control	10.38	11.63	12.56	13.34	13.85	14.16	14.34	14.56
Sodangi(6) × Control	8.76	10.66	11.58	12.185	13.58	13.88	14.14	14.43
Co9 × Control	10.96	11.55	12.14	12.36	12.94	13.88	14.24	14.35
T20 × Phorate-10G	11.48	12.15	12.86	13.66	13.98	14.19	14.44	14.64
Sodangi(6)×Phorate-10G	10.49	11.34	11.76	13.28	13.95	14.29	14.48	14.69
C09 × Phorate – 10G	11.39	11.76	12.39	12.99	13.85	14.27	14.43	14.64
T20 × Furadan – 3G	11.38	12.08	12.44	13.63	13.98	14.28	14.42	14.43
Sodangi × Furadan – 3G	10.38	11.49	11.96	12.56	13.74	14.28	14.34	14.46
Co9 × Furadan – 3G	10.95	11.85	12.25	12.68	13.44	13.98	14.30	0.029
SEm±	0.029	0.045	0.062	0.026	0.035	0.028	0.018	0.059
CD at 5%	0.086	0.145	0.183	0.078	0.104	0.079	0.054	

Table 4. Correlation coefficient of different components of *Ragi* treated with pesticides during development

	Days after flowering			
	6 day		5 day	
	Starch	Protein	Starch	Protein
Sugar	0.619	0.558	0.0009	0.524
Starch		0.844		0.393
	10 day		15 day	
	Starch	Protein	Starch	Protein
Sugar	0.242	0.346	0.098	0.375
Starch		-0.349		-0.314
	20 day		27 day	

	Starch	Protein	Starch	Protein
Sugar	-0.128	-0.036	-0.024	-0.126
Starch		0.044		0.476
	34 day		**41 day**	
	Starch	Protein	Starch	Protein
Sugar	0.099	0.029	-0.253	-0.335
Starch		-0.156		0.814

REFERENCES

1. Hartree, E.F., A modification of Lowery method that gives a linear photometric response. *Analytical Biochemistry*, **48** : 422-9 (1972).
2. Lowery, O.H., Rosebrough, N.J., Farr, A.I. and Randall, R.J., Protein measurement with the phenol reagent, *Journal of Biological Chemistry,* **193,** 265-75 (1951).
3. Martin, D.A., Miller, S.D. and Alley, H.P., Small grain response to herbicides (Abstract), *In proceeding of the Western Society of Weed Science,* **39**, 178-9 (1986).
4. Petibskaya, V.S., Effect of propanid and Saturn on the protein and amino acid content of the grain in different rice varieties. *ByulletenNauchno-Vsesoyuznoo Naucho Issledovatel' skogo Institute Risa,* **34** : 22-3 (1985) *From Referativnyi Zhwrnal*, (1987).
5. Prensser, E., Khallil, F.A. and Boldt, R., Influence of some pesticides on the activity of granulum-bound starch synthetase and on the nucleic acid, protein and carbodydrate content in *Zea mays and Vicia feba* major L., *Acta Physiologiae Plantarum,* **6(2)**, 65-74 (1984).
6. Rajoo, R.K., Herbicidal influence on the information on plant constituents in field maize (*Zea Mays* L.), *Pesticides,* **15**(7), 17-9 (1981).
7. Toriu, S., Kaneto, A. and Watanabe, T., Difference in effect of herbicides injury between naked baley and wheat, *Weed Research Japan,* **28(2)**, 106-10 (1983).
8. Tisguida, S., Dougias, A.F., James, H.C. and Kwanchal, A.G., Laboratory manual for physicological studies of rice, *IRRI The Philippines*, pp. 13 (1972).

❑