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3rd Regional Wheat Workshop

Tunis, Tunisia
APRIL 28-MAY 2, 1975

PROCEEDINGS

THIRD REGIONAL WHEAT WORKSHOP

- Durum Wheat Improvement
- Weed Control
- Crop Rotation with Annual Forage Legumes
- Seed

Tunis, Tunisia
APRIL 28-MAY 2, 1975

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RECENT DEVELOPMENTS IN DURUM WHEAT RESEARCH IN ITALY

A. Bozzini

This presentation is represented by the author's summary, highlights of the material presented, discussion which followed the presentation and the author's tables.

Summary by the author

An attempt is made to give some information on the history and development of durum wheat research in Italy, with particular emphasis on breeding and physiological studies and agronomical aspects of its cultivation. In relation to the main problems related to morphological and physiological ideo-type of durum wheat, different attempts for finding the correct germplasm to be used for fulfilling the goal are illustrated by a description of the subsequent varieties released in the last 30 years. Quality problems are afterwards taken into consideration, some of which are still to be resolved, particularly if breeding techniques are taken into consideration.

Finally, nitrogen uptake, metabolism and protein accumulation researches are dealt with, particularly in relation to the response to nitrogen fertilization of some key enzymes, like nitrate reductase and proteases.

Highlights of the material presented

1. Grifoni and Capeiti were good varieties improved from locals.

2. Yield is related to nitrate reductase level from heading to maturation.

3. There is a direct correlation between protease activity during ripening and the protein level in the kernels.

4. Nitrate reductase in roots is important for nitrogen intake in the vegetative stage.

5. For transport of nitrogen to the grain, the upper plant parts are important, especially the leaf sheaths and blades.

6. From jointing to maturity yield is related to nitrate reductase activity and from flowering to maturity the correlation is high.

7. The flag leaf is the best tissue for determination of nitrate reductase activity. Leaf area and position must be taken into consideration.

Notes on the tables and figures

Table 1. Is a summary of 6 yield trials in 1973-74, conducted in Italy by various cooperators. The top yielding varieties were Valsacco, Creso, Valselva, Valnova and Velgerardo. In these tests Creso combined excellent hectoliter weight with high yield. Also percentage yellow berry in Creso tended to be lower than in the Val-varieties, especially under conditions resulting in low yellow berry levels. Trinakria was the least affected by yellow berry; however, it was the lowest yielder in these tests.

Table 2. Is a summary of many trials carried out by the agricultural products laboratory (Laboratorio Applicazioni in Agricultura). Average values of all varieties in the trials for yield, hectoliter weight and percent yellow berry are compared with average values of Creso and Capeiti.

Table 3. Presents yield results of 6 durum wheat trials conducted at Ente Sviluppo in 1973-74. The variety Creso consistently produced a high yield.

Table 4. Presents yield results of 15 selections and four varieties, including Creso, at 2 levels of nitrogen at 4 locations in Central Italy in 1973-74.

Table 5. Compares yield and hectoliter weight performance of 12 bread and 4 durum wheats in 3 trials conducted at Ente Maremma 1973-74. The yield of Creso was better than the average of the bread wheats, and in two trials the hectoliter weight was better than any of the bread wheats.

Figure 1. Illustrates the relationship between nitrate reductase activity and protease in 10 varieties. A significant correlation exists if the two varieties with lowest protein and protease levels are omitted.

Figure 2. Illustrates the change in total nitrogen content, soluble protein, protease level and nitrate reductase activity as the growing season progresses.

Values given are the average of 10 varieties. Total nitrogen declined steadily from mid May to mid June. Nitrate reductase activity held steady from May 20th to June 6th, but dropped rapidly from June 6th to June 14th. During this latter period the protease level rose rapidly while soluble protein declined.

Figure 3. Illustrates a dramatic increase of percent and total grain protein as application of nitrogen fertilizer was increased from 0 to 400 kgs/ha. Also there is a corresponding increase of nitrate reductase activity sampled at heading stage or throughout the season and expressed as seasonal average.

Figure 4. Illustrates the close relationship between nitrate reductase activity at heading stage and both grain yield and grain plus straw yield. The influence of nitrogen application rate on these values is also shown.

DISCUSSION

Question: Do these differences in nitrate reductase activity result in increased grain yield or just in increased protein content of the grain.

Answer: Nitrate reductase activity is related to N uptake and translocation; therefore it influences both yield and grain protein content.

Question: (1) Is the relationship between the nitrate reductase activity and the yield linear? (2) What is the potential use of this technique in increasing production? (3) What is the relationship with the other nutrient elements and their effect on yield?

Answer: (1) Based on our experiments on durum wheat, nitrate reductase activity and grain yield follow a linear regression from 0 up to 200 kg **N**/ha. Measured by total yield (grain plus straw) the relationship holds from 0 to 400 kg N/ha. (2) The impact of this technique on our production falls in two categories: as a selection tool and as a way of assessing the nutritional status of the crop at a given moment. (3) The other nutrients are important in relation to availability, soil structure, plant canopy, etc. and the usual relationships with nitrogen metabolism apply.

Question: Is the level of nitrate reductase activity also dependent on nitrogen supply or is it purely genetical.

Answer: Nitrate reductase is an induced enzyme, therefore from the very beginning it depends on nitrate availability in the soil. Genetic factors are however, responsible for the general level of nitrate reductase activity.

Question: At what critical stages of plant development can high levels of nitrate reductase be used to predict high yield and high protein level in the grain.

Answer: According to our results, nitrate reductase activity of flag leaves from heading to the soft dough has the highest correlation coefficient with yield and protein content.

Question: Which are the easy and fast screening techniques for durum pasta making quality?

Answer: At present such techniques are not available. However, it seems that pasta quality (and gluten quality) may be closely related to the number and position of (SH-HS) groups. If this is demonstrated an easy technique may be available.

Comment by Dr. Scaracia: I wish to stress the importance of gluten quality and of rheological properties of the dough (tenacity, viscosity, elasticity) and, consequently, the need of identifying a parameter connected with these properties which is easy to detect in a small sample. There is evidence that disulphide bonds of the protein, which gives rise to the gluten, play an important role in the cohesiveness of the dough. Since disulphide bonds and thiolic groups are roughly proportional these groups should be a good parameter of the gluten quality and therefore pasta quality.

Question: What are your hopes of interspecific crosses and would you make a brief resume of what was done in this field in Italy?

Answer: Interspecific crosses have been a very useful tool for transfering interesting characteristics into durum wheat such as the work done in Italy. Mr. Maliani started using interspecific crosses about 20 years ago, followed by many other workers. Characters that have been transferred from hexaploid to durum wheat are mainly: spike and spikelet fertility, winter habit, winter survival, disease resistance, lodging resistance.

TABLE 1. GRAIN YIELD AND QUALITY DATA: MEANS, MAXIMUM AND MINIMUM OF 6 LOCATIONS. FROM THE "ITALIAN REGIONAL DURUM WHEAT VARIETIES TRIALS, 1974, ORGANIZED BY ISTITUTO SPERIMENTALE PER LA CEREALICOLTURA

	Grain yield moisture content 14% Q/Ha			Test weight Kg/hl			1000 Kernel Weight			Protein on dry matter basis						Lysine on dry matter basis						Lysine % of protein		
										%			Kg/Ha			%			Kg/ha					
	m.	max.	min.	m.	max.	min.	m.	max.	min.	m.	max.	min.	m.	max.	min.	m.	max.	min.	m.	max.	min.	m.	max.	min.
Valsacco	45,5	60,1	36,8	78,9	80,9	75,2	45,5	53,5	39,8	10.72	11.30	8.99	416	509	300	0.30	0.34	0.28	11.8	15.1	8.9	2.84	3.29	2.53
Creso	45,5	54.7	36.6	84.3	86.1	80.8	53.0	60.8	48.2	11.00	12.76	8.55	431	504	268	0.29	0.35	0.27	11.5	14.0	8.5	2.71	3.19	2.30
Valselva	45.1	52.3	40.4	81.4	83.5	78.5	50.9	59.8	44.5	11.06	13.27	9.33	426	490	326	0.31	0.34	0.27	11.9	14.2	9.5	2.81	3.34	2.34
Valnova	44.0	53.2	38.7	81.5	82.9	78.1	52.8	61.2	46.5	11.59	12.57	9.75	438	522	324	0.28	0.32	0.24	10.5	12.0	8.1	2.40	2.73	2.11
Valgerardo	42.0	47.4	37.8	81.9	83.5	78.0	49.9	58.3	46.7	10.57	11.97	8.31	382	469	270	0.30	0.32	0.27	10.5	11.7	8.9	2.79	3.28	2.24
Tito	38.8	54.4	30.2	78.9	82.5	74.3	36.9	45.0	32.1	11.16	12.82	9.33	376	496	233	0.31	0.36	0.24	10.4	13.3	7.6	2.81	3.28	2.30
Appulo **	37.2	40.9	32.7	82.7	84.8	80.0	43.8	53.3	40.8	12.03	14.76	10.15	395	466	328	0.30	0.35	0.26	9.6	10.9	7.2	2.49	3.09	2.02
Belvedere	37.1	45.3	28.3	81.2	83.4	77.0	42.1	48.0	38.9	11.55	15.36	9.12	360	402	278	0.34	0.36	0.30	10.9	13.4	8.0	3.01	3.36	2.13
Valgiorgio	36.9	46.3	29.2	79.9	81.6	75.8	47.3	60.1	41.5	11.46	12.76	9.12	363	442	263	0.31	0.33	0.28	9.7	11.8	7.1	2.70	3.10	2.38
Valfiora	36.5	46.4	30.2	81.7	82.9	79.8	54.2	64.9	47.2	12.11	13.33	9.75	380	473	269	0.33	0.37	0.29	10.4	14.1	8.4	2.75	2.99	2.50
Valnera	35.3	41.2	30.5	81.2	82.6	78.3	54.0	60.3	46.1	11.19	13.37	8.88	361	406	245	0.29	0.34	0.22	9.1	11.6	5.0	2.31	2.87	2.21
Raineri	35.2	48.3	33.0	80.8	83.2	76.3	40.6	49.9	35.7	12.52	14.89	10.15	376	440	265	0.33	0.35	0.30	10.0	14.6	6.8	2.67	3.35	2.05
Maristella	35.1	38.4	27.0	82.7	84.4	78.9	45.8	54.3	38.8	12.21	14.01	10.15	371	462	235	0.33	0.38	0.28	10.0	11.6	7.3	2.72	3.11	2.38
Pepe 64	34.9	40.6	23.8	83.4	85.0	80.5	45.9	55.0	40.7	12.58	14.01	9.55	381	460	196	0.30	0.34	0.24	8.9	11.8	6.2	2.40	3.14	1.89
Sincaro 9	34.1	41.3	28.3	83.1	84.8	80.9	41.2	48.7	36.9	11.40	14.01	8.88	334	440	228	0.31	0.33	0.28	9.2	11.7	7.3	2.81	3.21	2.16
Pepe 0130	34.0	37.2	27.7	83.0	84.5	79.4	49.0	57.6	41.8	12.09	13.72	9.75	355	435	231	0.31	0.37	0.26	9.1	10.8	7.0	2.69	3.42	2.18
B.52	33.2	40.2	27.0	82.9	84.4	80.2	42.5	50.4	37.8	11.15	13.59	7.96	319	410	195	0.32	0.37	0.26	9.2	12.5	6.4	2.92	3.46	2.45
Capeiti 8	31.9	37.6	23.1	83.1	85.9	79.2	43.8	55.6	36.1	11.58	14.01	9.96	319	434	199	0.30	0.33	0.24	8.1	10.3	4.9	2.57	3.22	2.27
Himera	30.7	37.8	22.8	83.6	84.8	82.1	45.5	56.0	38.8	13.85	15.91	10.35	369	512	203	0.36	0.40	0.32	9.3	12.8	7.6	2.62	3.81	2.23
L.51	29.9	36.0	26.6	82.0	83.5	79.5	39.8	47.1	34.7	11.07	13.24	7.96	286	352	182	0.32	0.36	0.28	8.2	9.7	6.5	3.02	3.67	2.63
Camposoro	29.7	42.0	18.5	82.7	84.2	79.9	37.0	47.2	32.7	13.48	15.51	11.21	342	421	226	0.34	0.39	0.27	8.5	10.4	5.0	2.48	2.71	2.20
Granato	29.2	39.4	25.2	83.5	84.8	81.7	48.8	59.5	45.1	13.85	16.52	11.16	340	426	252	0.34	0.37	0.31	8.5	10.7	6.7	2.46	2.85	1.99
Cappelli	28.1	33.0	20.4	82.9	83.8	80.7	50.9	61.2	44.0	12.40	14.67	9.86	299	362	246	0.33	0.44	0.23	8.1	12.7	5.0	2.69	3.52	1.92
Eliodoro X	27.6	31.5	24.9	82.7	84.5	80.3	42.1	56.5	33.5	12.58	14.33	10.96	362	328	256	0.31	0.34	0.27	7.4	8.2	6.4	2.50	2.68	2.30
Trinakria	26.6	35.5	13.4	80.7	83.3	77.3	50.7	58.1	43.2	15.37	17.50	10.66	359	516	123	0.37	0.41	0.33	8.6	12.5	3.8	2.46	3.05	2.12
Mean	35.4			82.0			46.1			12.05			366			0.32			9.6			2.67		

X Mean of 4 locations: Roma, Catania, Palermo, Cagliari

** underlined means have been obtained from all locations except Catania.

Table 2. Summary of tests made by the agricultural products laboratory (Laboratorio Applicazioni in Agricoltura)

Location and year	No. of lines tested	Yield Qx/ha.			Hectoliter weight			Yellow berry. %		
		Ave.	Creso	Capeiti	Ave.	Creso	Capeiti	Ave.	Creso	Capeiti
Casaccia 63-69	35	35.33	57.70	44.52	81.65	85.89	82.09	38	34	17
Casaccia 69-70	43 x 2	46.93	50.72	4[illegible]	82.63	85.40	84.70	40	15	36
Casaccia 70-71	72 x 2	53.80	67.95	53.20	81.14	84.30	80.98	9	22	10
Casaccia 71-72	71 x 2	47.28	50.55	38.25	80.82	83.16	81.35	14	5	10
Casaccia 71-72 (FAO)	12	38.75	46.50	37.66	78.49	82.58	80.48	4	1	2
Casaccia 71-72 (CNR)	14	38.76	53.91	43.03	70.15	82.65	80.07	4	2	4
Casaccia 71-72	52	53.97	60.11	42.12	79.32	82.23	80.28	14	2	4
Casaccia 71-72	52	37.33	56.10	--	76.90	81.40	--	6	3	--
Casaccia 71-72	27	44.66	50.14	--	77.12	78.80	--	18	13	--
Casaccia 71-72	14	46.08	49.05	--	75.29	79.01	--	39	34	--
Casaccia 71-72 Rockefeller	26	47.25	47.13	40.82	80.08	82.61	82.31	18	5	15
Casaccia 71-72	41	44.31	46.54	43.17	77.19	80.13	79.01	35	20	36
Casaccia 71-72	49	50.14	54.38	41.05	74.70	79.95	77.75	25	17	27
Casaccia 71-72	49	50.24	48.13	45.59	75.77	80.73	78.35	24	5	26
Casaccia 71-72	46	56.67	63.00	35.12	75.59	80.45	77.38	10	10	10
Casaccia 71-72	46	47.84	57.66	37.92	77.43	80.88	79.16	20	6	7
Casaccia 71-72	46	37.94	50.17	36.97	76.87	81.35	78.65	14	21	16
Casaccia 72-73	71 x 2	57.50	57.47	56.96	80.48	83.81	84.17	7	2	5
Casaccia 72-73 (CNR)	16	49.91	51.27	50.27	82.74	82.73	83.90	8	9	11
Casaccia 72-73 (FAO)	12	49.88	51.09	52.24	82.42	83.33	84.41	12	14	10
Casaccia 72-73 epoca semina	5	43.47	41.94	47.56	81.66	82.71	84.43	10	3	45
Casaccia 72-73 epoca semina	27	48.03	51.43	57.99	80.86	82.40	84.18	2	1	2
Casaccia 72-73 epoca semina	42	47.61	51.94	48.13	82.24	81.93	83.11	2	1	2
Casaccia 72-73 epoca semina	42	44.09	50.44	49.38	82.27	82.48	83.65	3	3	7
Casaccia 72-73 epoca semina	38	46.16	47.36	--	82.01	81.26	--	1	1	--
Casaccia 72-73 epoca semina	38	43.50	48.53	46.25	81.60	82.46	83.12	2	2	7
Casaccia 72-73 epoca semina	56	41.97	46.15	44.44	80.10	81.40	83.50	1	1	1
Casaccia 72-73 epoca semina	56	41.25	45.23	--	79.02	81.40	--	2	1	--
Casaccia 72-73 epoca semina	61	44.27	47.37	41.15	80.81	82.53	83.31	2	3	4
Casaccia 72-73 epoca semina	61	40.77	43.45	37.89	81.71	33.13	84.10	7	5	13
Ancona 69-70	43 x 2	46.97	53.57	50.50	80.29	84.30	81.90	2	1	1
Ancona 70-71	72 x 2	38.11	45.12	25.35	79.89	83.20	76.70	1	1	1
Ancona 71-72	73 x 2	46.37	61.20	41.05	78.05	83.73	78.91	1	3	1
Ancona 72-73	69 x 2	54.51	66.04	57.37	75.22	79.85	78.90	4	5	3
Tarquinia 70-71	73 x 2	23.35	22.68	27.22	81.42	82.10	84.95	1	0	1
Tarquinia 71-72	76 x 2	35.90	37.82	35.16	76.25	78.60	79.50	8	1	5
Tarquinia 72-73	71 x 2	41.23	39.15	45.12	75.78	76.46	79.47	4	0	2
Maccarese 69-70	10 x 2	42.75	54.91	35.57	80.16	84.03	81.02	9	21	15
Maccarese 70-71	14 x 2	38.11	61.94	36.03	82.79	85.11	82.45	1	1	2
Maccarese 70-71	15 x 2	57.45	77.25	--	81.30	85.62	--	14	17	--
Maccarese 71-72	32 x 2	42.62	61.12	33.70	77.09	82.48	79.53	6	1	1
Maccarese 71-72	11 x 2	34.16	58.46	--	76.75	82.71	--	8	5	--
Maccarese 72-73	20 x 2	49.44	50.37	--	83.60	85.57	--	19	12	--
Maccarese 72-73	16 x 2	62.58	66.55	--	81.80	83.85	--	28	36	--
Terni 69-70.	10 x 2	45.20	53.20	44.50	80.53	84.12	80.81	1	1	1
Terni 70-71	20 x 2	30.20	44.00	28.00	71.72	79.75	73.40	1	5	1
Terni 71-72	20 x 2	38.96	47.10	--	77.09	80.25	--	7	4	--
Terni 72-73	19 x 2	45.49	48.04	--	78.18	81.17	--	15	4	--
Avezzano 71-72	2 x 2	52.21	55.51	--	80.34	80.57	--	27	38	--
Avezzano 72-73	16 x 2	64.32	77.85	--	76.49	83.73	--	1	1	--

Table 3. Yield results of trials conducted by Ente Sviluppo in Tuscany and Lazio (1973-74).

Variety	Tarquinia (Vitterbo)		P. Mirteto (Rieti)		Barbaruta (Grosseto)		Riotorto (Livorno)		Buonconvento (Siena)		Average	
	Yield Qx/ha.	Rank	Yield Qx/ha.	Rank	Yield Qx/ha.	Rank	Yield Qx/ha.	Rank	Yield Qx/ha.	Rank	Yield Qx/ha.	Rank
1) Appulo	35.71	10	--	--	37.40	24	34.39	18	31.60	7	34.77	25
2) Creso	37.85	1	43.90	1	69.93	1	48.42	1	37.20	1	47.49	1
3) FC 120	31.71	20	--	--	--	--	35.97	15	30.40	11	32.89	32
4) FD 1156	29.28	27	--	--	--	--	35.07	15	34.70	4	33.01	29
5) FD 1514	34.57	12	--	--	62.29	5	43.66	6	--	--	46.84	2
6) FD 1543	39.71	23	--	--	62.44	5	41.63	8	--	--	44.82	5
7) FE 137	28.14	31	35.20	6	48.72	13	--	--	--	--	37.35	17
8) FE 164	33.71	17	32.60	11	--	--	--	--	--	--	33.15	29
9) FE 484	26.14	38	--	--	58.07	8	--	--	--	--	42.10	8
10) FE 1705	17.14	47	37.20	4	--	--	--	--	--	--	27.17	45
11) FE 1706	36.42	6	--	--	--	--	38.03	10	--	--	37.72	17
12) FE 1708	21.14	46	29.80	15	45.30	17	--	--	--	--	32.41	32
13) FE 3017	26.42	38	--	--	64.40	3	--	--	--	--	45.41	4
14) FE 3023	32.57	19	35.80	6	45.70	18	--	--	--	--	38.02	16
15) FE 3066	28.85	31	--	--	65.16	2	45.36	3	--	--	46.46	3
16) FE 3068	38.28	1	--	--	--	--	42.68	7	29.80	12	36.72	20
17) FE 3091	36.42	6	--	9	42.08	20	--	--	--	--	37.70	17
18) FE 3097	29.28	27	34.60	11	--	--	--	--	--	--	30.99	36
19) FE 3297	27.71	37	32.70	10	--	--	--	--	--	--	30.70	36
20) FE 3302	34.57	12	33.70	--	48.87	13	--	--	--	--	41.72	9
21) Gerardo 522	29.71	27	--	--	--	--	--	--	--	--	29.71	42
22) Gerardo 523	28.26	31	--	--	--	--	--	--	--	--	28.23	43
23) Gerardo 613	34.00	12	--	--	--	--	--	--	--	--	34.00	23
24) Gerardo 619	26.85	36	--	--	--	--	--	--	--	--	26.85	46
25) Gerardo 620	28.14	31	--	--	57.77	9	40.84	9	31.50	7	39.56	13
26) Gerardo 629	35.71	10	--	--	--	--	--	--	--	--	35.71	22
27) Gerardo 634	26.14	38	--	--	--	--	--	--	--	--	26.14	47
28) Gerardo 635	33.28	17	--	--	--	--	--	--	--	--	33.28	29
29) Gerardo 644	28.57	31	--	--	--	--	--	--	--	--	28.57	43
30) Gerardo 645	26.43	33	--	--	--	--	--	--	--	--	26.43	47
31) Hymera	36.85	6	--	--	--	--	34.28	18	--	--	35.56	22
32) Linea 6259	30.00	23	--	--	--	--	--	--	--	--	30.00	40
33) Linea 6587	31.85	20	37.40	4	59.88	7	48.87	1	--	--	44.50	6
34) Linea 7418	34.18	12	35.30	6	41.62	21	32.69	20	34.00	4	35.55	22
35) Linea 7614	37.85	1	--	--	--	--	27.26	23	--	--	32.50	32
36) Linea 7635	38.14	1	--	--	--	--	31.11	21	--	--	34.62	25
37) Montanari	34.71	12	30.40	14	41.93	21	37.23	12	36.50	3	36.17	20
38) Patrizio	26.85	38	--	--	31.24	23	35.41	15	34.80	4	32.82	32
39) Pepo 64	23.42	31	25.60	18	43.29	19	39.14	10	37.60	1	34.81	23
40) Raineri	26.14	38	21.70	19	39.21	13	37.67	12	31.50	7	31.24	36
41) Tenero locale	31.14	20	28.60	16	55.05	10	44.91	5	--	--	40.07	11
42) Tito	29.71	27	42.30	2	48.72	13	45.25	3	31.00	7	39.39	13
43) Trinacria	30.42	23	--	--	--	--	31.45	21	--	--	30.93	36
44) Val Gerardo 451	--	--	39.30	3	--	--	--	--	--	--	30.30	13
45) Val Gerardo 512	38.28	1	36.60	17	64.40	3	--	--	--	--	43.09	7
46) Valnera	25.71	45	--	--	--	--	--	--	--	--	25.71	49
47) Valnova	30.28	23	--	--	--	--	--	--	--	--	30.28	40
48) Valsacco	--	--	--	--	51.73	12	37.89	12	30.20	11	39.91	11
49) Valseva	38.28	1	31.30	13	54.15	11	--	--	--	--	41.14	9
Average	31.09	--	33.35	--	51.83	--	38.68	--	33.14	--	35.58	--

Table 4. Yield in quintals per hectare of Creso and other lines at 4 locations of central Italy, 1973-74.

	Casaccia		Narni		Maccarese		Avezzano	
Linea	100kgN	150kgN	100kgN	150kgN	100kgN	150kgN	100kgN	150kgN
FE 1091	52.8	56.2	59.9	63.9	56.4	61.4	78.8	78.8
FE 1097	59.7	52.8	61.9	60.9	57.5	60.6	94.0	90.9
FD 1514	69.5	63.6	63.3	63.6	73.1	64.5	89.9	87.9
FD 1543	64.4	64.3	62.3	63.9	56.4	55.6	95.0	96.3
FE 3066	75.8	68.5	59.3	59.6	67.3	50.9	94.0	96.0
FE 3968	68.6	72.5	56.8	57.3	51.4	54.2	95.3	94.0
FE 3017	68.8	62.3	68.6	65.3	60.6	56.2	99.4	97.7
FE 3023	64.0	62.1	72.6	68.6	70.3	71.7	102.1	97.3
FE 3297	59.1	52.3	59.3	50.3	38.1	42.5	79.8	68.6
FE 3302	45.8	52.8	60.6	56.9	54.2	50.3	82.5	83.8
FE 164	57.7	42.0	62.3	56.9	57.0	54.5	85.5	71.0
FE 137	61.2	59.7	62.6	61.6	56.7	51.2	94.0	75.4
FE 484	65.9	63.6	68.6	67.9	54.8	48.4	98.4	82.5
FE 1705	71.5	67.2	60.3	64.3	58.4	52.8	89.6	81.5
FE 1706	53.7	52.4	61.6	65.9	56.7	55.6	90.6	75.4
Test	43.1(1)	38.9(1)	54.6(2)	57.3(2)	33.9(1)	33.6(1)	85.2(3)	81.8(3)
Creso	72.6	69.2	67.3	70.9	64.8	64.2	102.8	100.4
Tito	78.5	59.6	66.3	62.6	63.1	55.6	97.7	86.9
Mida	-	-	67.3	67.6	65.1	66.0	95.3	83.8

(1) Capeiti, (2) Irnerio, (3) (Produttore).

Table 5. Comparison of bread and durum wheats at 3 locations (Ente Maremma, 1973-74), (coastal area).

	Barbaruta (Grosseto		Marsiliana (Grosseto)		Casotto Pescatori (Grosseto)	
Variety	Yield Qx/ha.	Hecto. l. wt.	Yield Qx/ha.	Hecto. l. wt.	Yield Qx/ha.	Hecto. l. wt.
Orso	58.67	82.15	47.39	89.10	57.50	82.15
Costante	67.12	81.70	57.91	81.70	51.25	79.90
Generoso	49.47	81.70	47.91	82.60	53.00	85.30
Marzotto	49.62	80.35	44.16	82.80	47.50	78.60
Granarolo	56.41	79.45	60.31	82.15	54.50	75.90
M.E.C:	61.39	81.85	48.64	85.55	52.00	85.90
Strampelli	56.71	81.25	57.29	82.15	55.00	78.60
Irnerio	57.31	81.70	58.33	81.70	50.00	76.80
Gagliardo	57.31	80.35	52.03	79.45	56.00	76.80
Palata	56.86	81.70	53.75	81.70	61.00	80.95
Fontarronco	57.62	80.35	53.64	83.30	48.75	80.35
Resistente	-	-	50.31	84.40	-	-
Creso	64.40	86.20	49.89	85.75	59.50	82.60
Appulo	48.42	81.70	-	-	-	-
Tito	-	-	-	-	34.25	74.55
Raineri	-	-			41.50	79.45

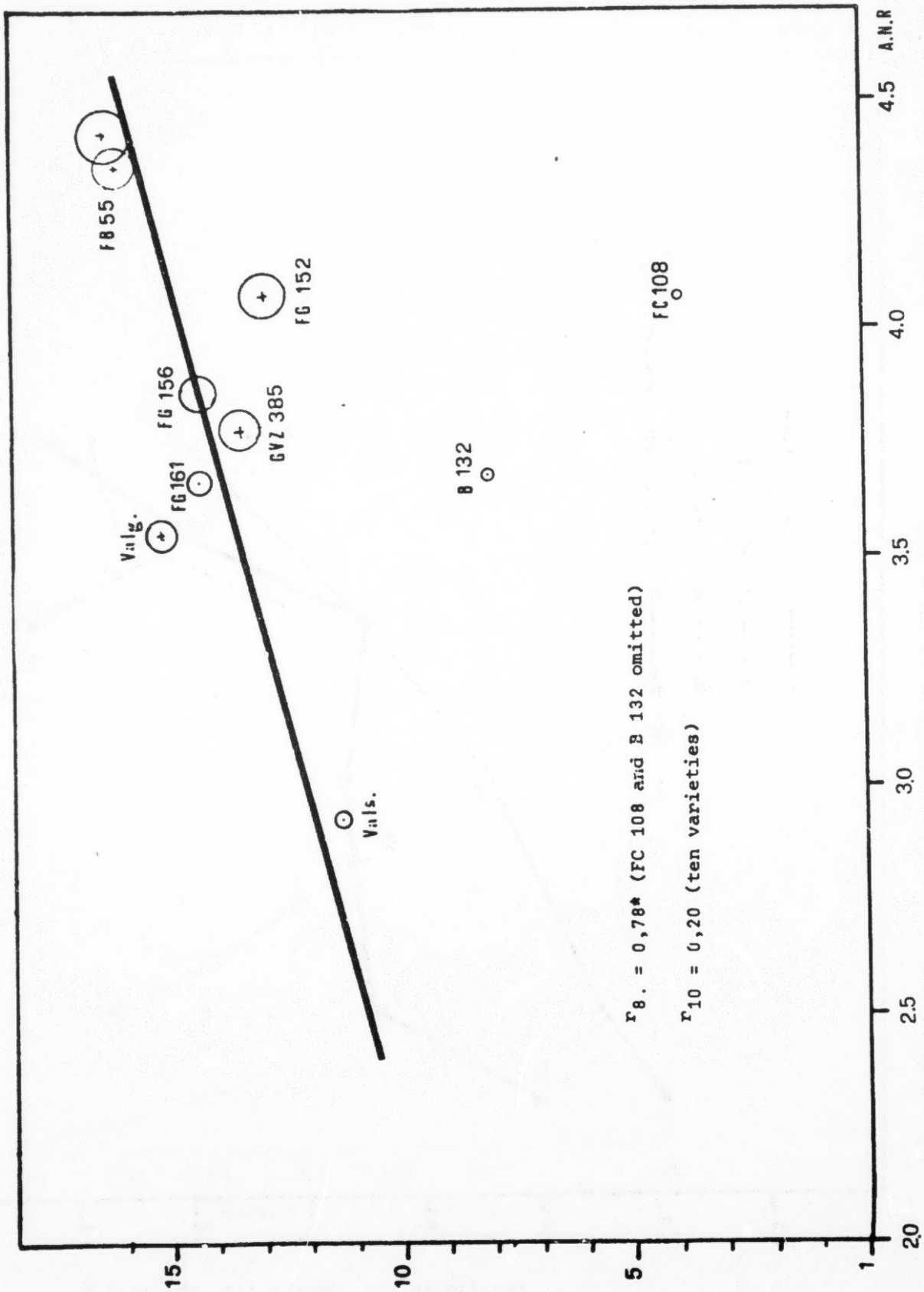

Figure 1. Correlation between nitrate reductase activity and protease (mg protein digested per hr. per gram fresh weight). The radius of the circles indicates the protein content of the grain.

Figure 2. Change in total N content, soluble protein, protease and Nitrate Reductase Activity with sampling date, each value is the average of 10 varieties.

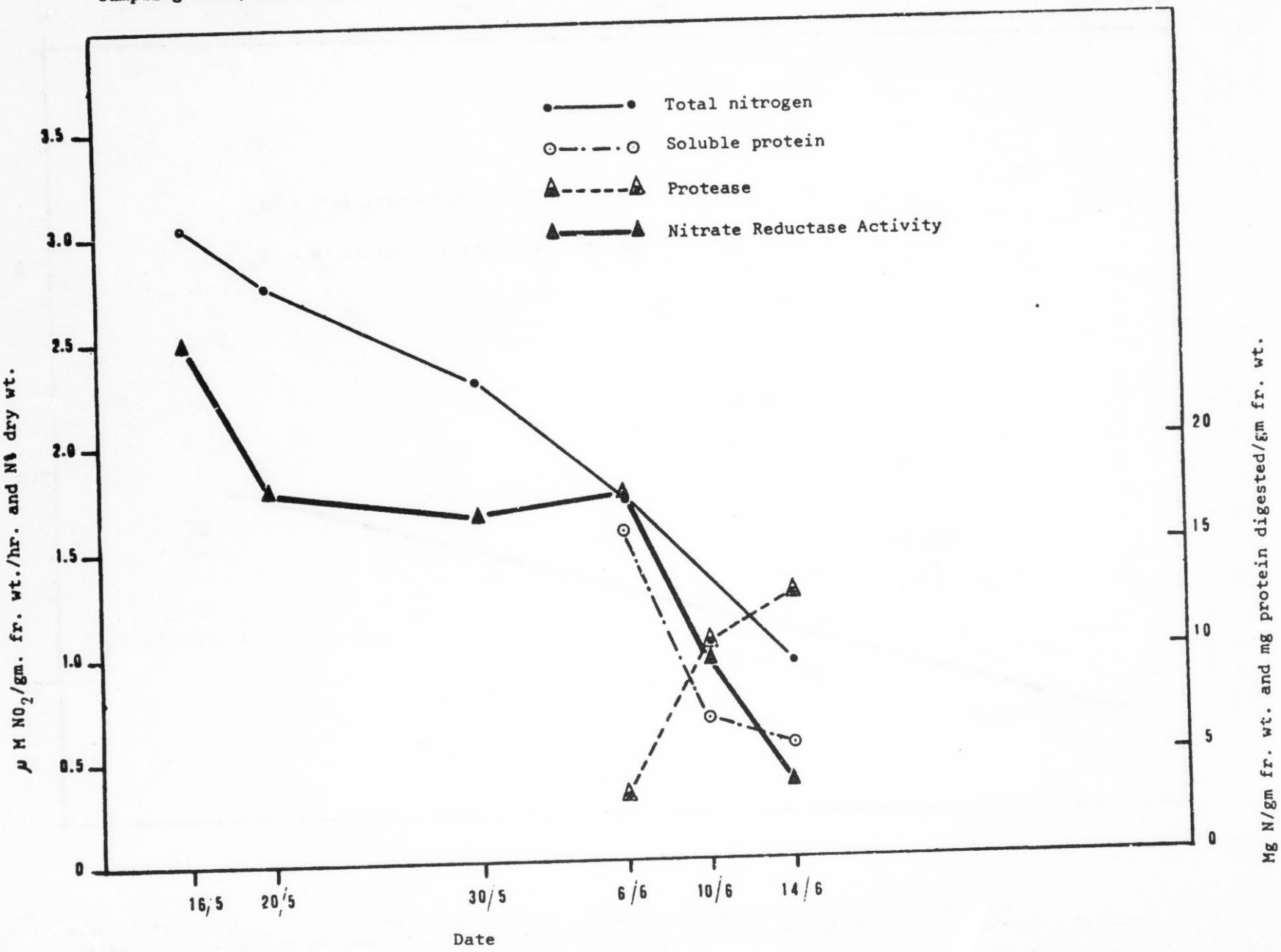

Figure 3. Effect of N fertilization on (A) percent of grain protein (⊙——⊙) and total grain protein (●——●), and on (B) N.R.A. (nitrate reductase activity) at heading stage (●——●) and as seasonal average (⊙——⊙).

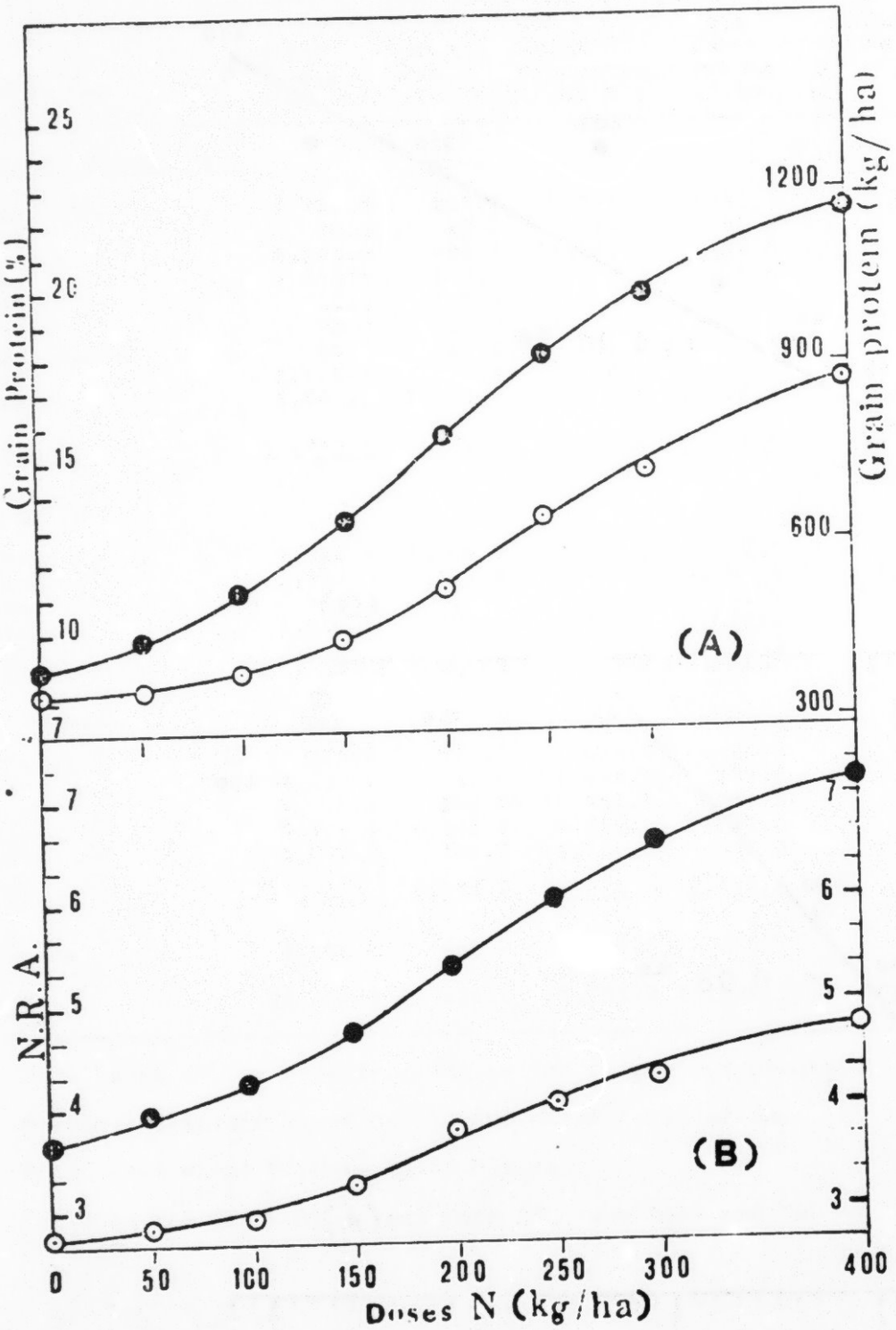

Figure 4. Relationship between N.R.A. (Nitrate reductase activity) at the heading stage and (A) grain yield, (B) grain and straw yield. The figure given at each point is the level of nitrogen applied which generated this point.

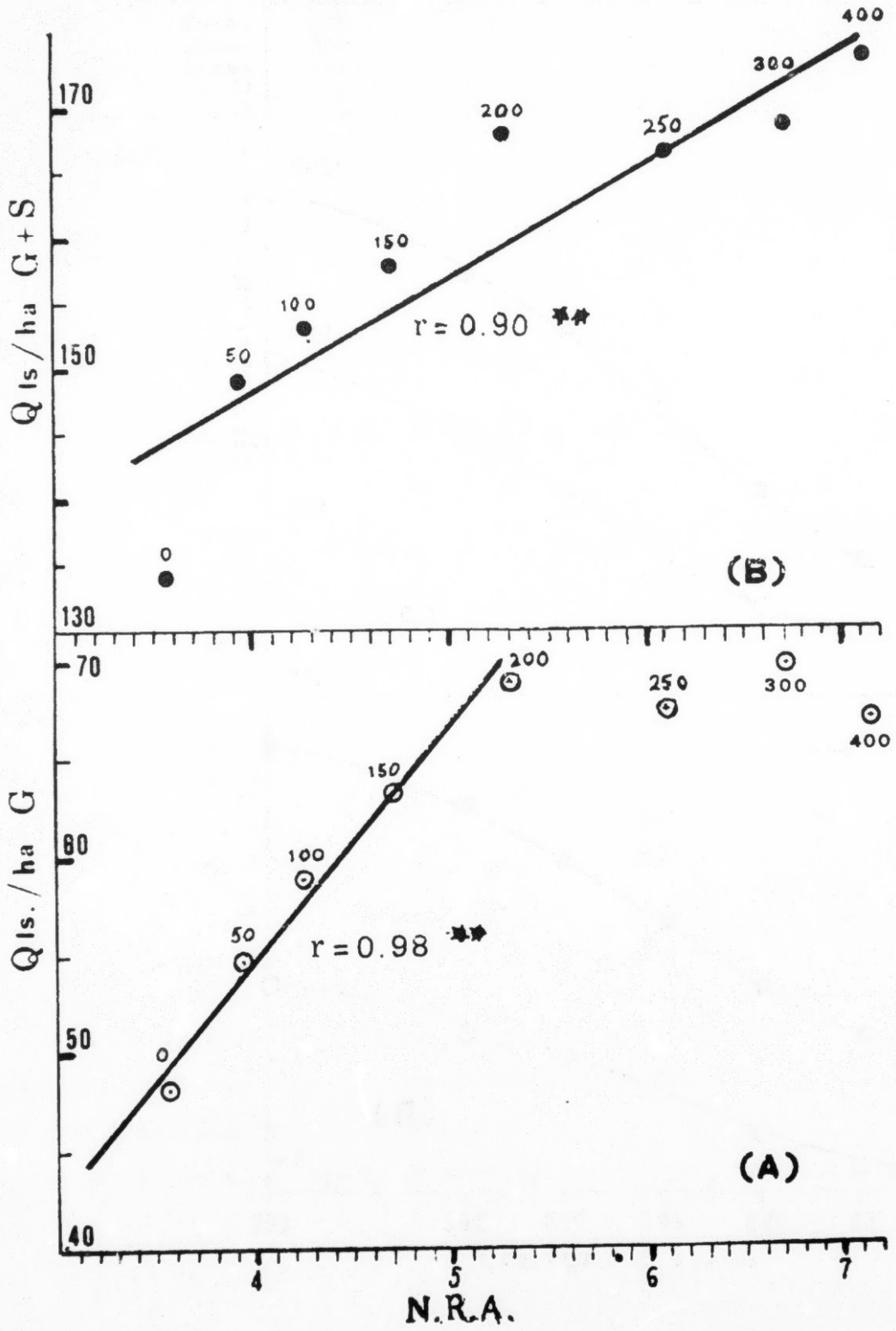

TABLE 1. Durum Distribution in the Mediterranean and Near and Middle Eastern Countries. 1/

Countries	Total Wheat Area 1000 ha)	Total Durum Area (1000 ha)	Total Wheat Production (1000 M.t.)	Total Durum Production (1000 M.t.)	Durum Needs	Durum Area %	% Durum Production
Near and Middle East							
Afghanistan	2,336.0	467.2	2,850.0	841.0	1,000	20.0	29.5
Cyprus	80.0	40.0	95.0	45.0	40	50.0	47.7
Iran 2/	4,885.0	488.5	4,251.0	425.0		10.0	10.0
Iraq	2,000.0	240.0	1,500.0	270.0	270	12.0	18.0
Jordan	200.0	190.0	150.0	140.0	300	95.0	93.3
Lebanon	52.6	17.0	75.0	20.0	50	32.3	26.7
Saudi Arabia	60.0	30.0	90.0	40.0		50.0	44.4
Syria	1,500.0	1,000.0	1,600.0	900.0	300	66.7	56.3
Turkey	8,600.0	2,200.0	10,000.0	2,400.0	2,500	25.6	24.0
S. TOTAL	19,713.6	4,672.7	20,611.0	5,081.0		23.7	24.6
N. Africa							
Algeria 3/	2,100.0	1,300.0	1,400.0	800.0	1,000	61.9	57.1
Morocco 2/	1,837.4	1,375.0	1,872.0	1,362.4	1,500	74.8	72.8
Libya	186.7	126.5	62.3	43.6		±70.0	
Tunisia	1,050.0	800.0	750.0	520.0	500	76.2	69.3
S. TOTAL	5,174.1	3,601.5	4,084.3	2,726.0		69.6	
Med. Europe							
Portugal 4/	568.0	80.0	454.0	80.0		14.1	
Spain 4/	3,587.0	232.0	5,449.0	259.0	200	6.5	
France 4/	4,034.0	100.00	14,459.0	250.0		2.5	
Italy 4/	4,218.0	1,380.0	9,585.0	2,100.0		32.7	
Greece 4/	1,078.0	290.0	1,724.0	426.0	320	26.9	
S. TOTAL	13,485.	2,082.0	31,671	3,115.0		15.4	
Ethiopia	1,091.6	982.4	839.5	657.7		90.0	78.3
G. TOTAL	39,464.3	11,338.6	57,205.8	11,579.7		28.7	20.2

1/ Data based on the reports given by the respective countries

2/ Personal estimate based on FAO and other publications

3/ Proc. 1st Wheat Workshop 1971 Mexico

4/ Based on FAO Production year book 26, year 1969 and FAO/RF Turkey Wheat Seminar

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