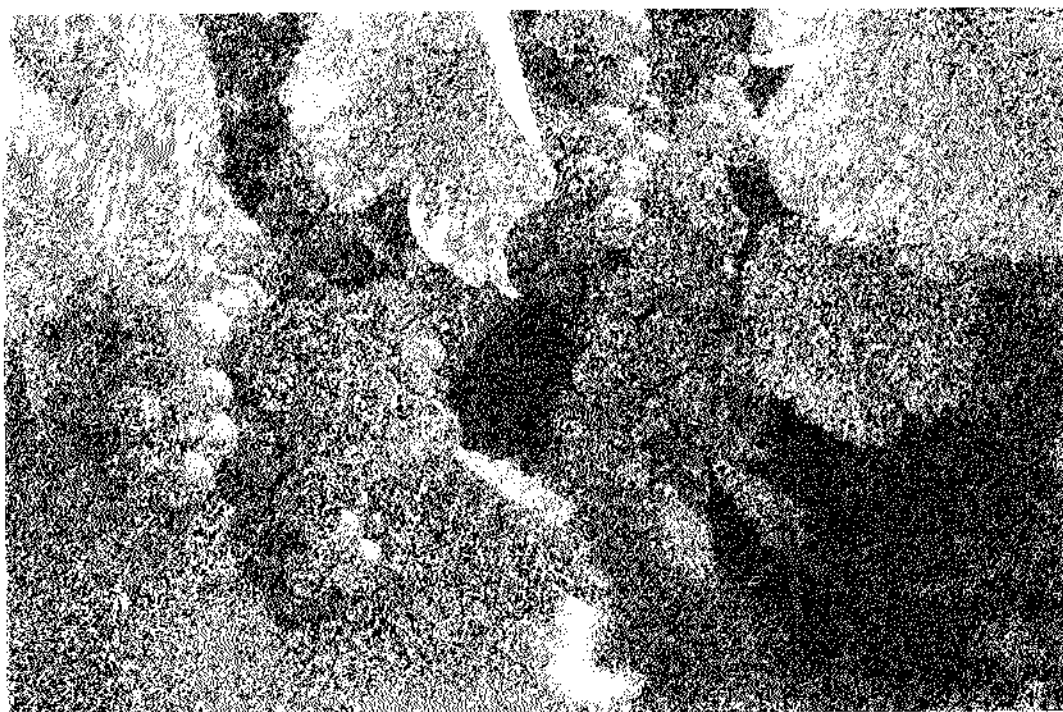


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Results of Examinations of the Medium-term Effect of Two Humus Fertilizers on Soil and Vine



Höhere Bundeslehranstalt und Bundesamt
für Wein und Obstbau
(establishment of secondary education and federal office of vine
and fruit growing)
Wiener Straße 74, 3400 Klosterneuburg/Austria

Trial Year 1998
Summary 1995 - 1998

Interpretation of Test Results Kreindlhof 1998

Effect of Biosol and Bactosol

A few clear nights resulted in minus temperatures down to -5 °C already before vintage from October 17 to 20, 1997, and on Oct. 29, -8 °C were recorded. On November 6. the thermometer exceeded the zero barrier until mid December, when four nights had temperatures between -7 °C and -3 °C. January remained in the zero range until the 25th. From January 26 to February 5, individual temperatures of -10 °C to -18 °C (Feb. 3) were recorded. There were only few days with frost (max. -5 °C) until March so that no frost damage was caused by the winter.

The vines of all variants were cut to the same degree (table 1).

Sprouting started in the first days of May and proceeded rather fast (table 6). The loss of buds was very small and no effects of the different variants have been found (table 2).

Table 3 shows a minimum loss of buds, expressed as frost damage in percent (%), which had no negative effect on the further development. As can be seen in table 5, the weights of pruned vines are normal, the Biosol 1000 variant slightly exceeding the reference variants. The wood weights tend to be slightly smaller as compared to the previous year.

The numbers of flower clusters per vine did not differ statistically from one another (table 8).

Blossoming started on June 5 when the first individual blossoms opened. This is the earliest blossoming time of the last years. As early as mid June, a rapid growth of grapes was observed.

The blossom drop was up to 10 % (variant 4), Biosol 1000 kg had a minimum value of 7.5 %. In general, values below 15 % are not regarded as damage due to blossom drop. Due to the great variance of blossom drop in the individual replicates of the Bactosol variants (var. 3 and 4), the null hypothesis was rejected during the variance-analytical examination, although the absolute value is negligible.

The N-min content in the soil was determined in 1998 as for the previous years. Samples were taken on August 3 and November 3. It has been found in particular during sampling in summer, that the higher application rates of Biosol and Bactosol built up a solid nitrogen supply for subsequent delivery in the soil, which was maintained until autumn.

A comparison of the formation of sugar at the beginning of the ripening period shows a clearly advanced ripening period as compared to the previous year due to an optimum distribution of precipitation. A persistent raining period starting at the beginning of September, which delayed the ripening process and necessitated a premature harvest due to rot. A precipitation of 129 mm was measured only for September, and for October 98 mm, which are entirely untypical precipitation results for the vine growing area.

In spite of the unfavourable weather conditions at the final ripening period in the trial vineyard, the grapes were harvested with an average of 18.5 ° KMW (Klosterneuburg must value; table 24). The quality-quantity law was revealed in the yields (table 21) with the treated variants showing values between 10 % (var. 3) and 15 % (var. 1) above the control. In addition to the yield, the sugar yield per hectare takes the must value into account:

Table: sugar yield 1998:

	kg/ha	rel. %
Biosol 500 kg/ha	1394	123
Biosol 1000 kg/ha	1272	113
Bactosol 500 kg/ha	1264	112
Bactosol 1000 kg/ha	1214	107
Control	1130	100

The yields differ slightly in favour of the treated variants. Table 22 reveals that the higher yields are caused by a better grape formation (control: about 180 g/grape, treated: about 208 g/grape). Like the must values, the acid values of the musts do not differ significantly.

Summary of the Examinations of the Medium-term Effect of Two Humus Fertilizers (Biosol and Bactosol) on Soil and Vine (1995 - 1998):

The nutritional condition of the trial soil was determined and the general test conditions were specified already before the first application of Biosol and Bactosol.

The sorption capacity of this loess site is to be classified as average to high, the lime content as very high. In addition to a very good supply with main and trace nutrients, their availability is also described as good. The humus values also lie in a favourable range between 2.6 and 3.4 %.

After the application of Biosol and Bactosol, an increase of the mineral nitrogen content in the soil was found which was in accordance with the application rates. Every year in June, a slight reduction occurred due to extraction by plants. An increased N-min reduction was measured only in the control.

As early as 1996, a slight advantage of the treated variants as compared to the control was found with regard to blossoming. The soil nitrogen values determined in the pre-blossom stage also showed a positive trend of the NO₃ values in the top soil. Since also higher nitrate values were found during sampling for the nitrogen determination in autumn, greening of the soil in winter is to be recommended. A natural green cover had grown in the trial lot. It is remarkable that the nitrogen supply of the top soil was higher in 1996 - in spite of the high precipitation rate - than in 1995. As early as 1996, a significant increase of the yield became apparent in the treated variants, resulting from a greater number of flower clusters per young sprout and higher

weights of single grapes. The sugar yield per hectare (see the first table of 1996) exceeded the unfertilized lot in the 500 kg fertilizer variants by 11 or 19 %, in the 1000 kg variants by 22 or 17 %.

In 1997, the blossom drop of the treated variants (5 replicates) was between 8.5 and 13 %: only the control variant had a blossom drop of about 15 %. A better nutrient supply in the soil may be an explanation for this phenomenon. The N-min determination of the soil samples in spring showed balanced values between the variants. Due to extraction by plants (strongest absorption by vines and undergrowth), the pre-blossom determination showed hardly any nitrogen quantities in the soil. A mineral supplementary fertilization would have had a positive effect, but was not performed due to the trial specifications. Sampling in autumn revealed an increase of the nitrogen values in the top soil of variants 2 and 4, but not in deeper soil layers, which shows that the biomass of the soil prevented a transfer to deeper layers. For this reason, the soil was not loosened in autumn. In general, also for that trial year a more favourable nitrogen curve during the vegetative period has been determined in the fertilized variants. The yield values of that year therefore could not be clearly distinguished.

In the year of the report 1998, the conditions for vine development were very favourable. Samples taken during summer for N-min analysis showed the better condition of the treated variants with regard to the nitrogen content. Although there was a considerable advancement of ripening as compared to the previous year, a raining period necessitated harvesting on October 17. However, sugar values in the higher cabinet range were achieved without exception (18.5 ° KMW - Klosterneuburg must value - on average).

The yield values revealed the advantages of Biosol or Bactosol application. When averaging the trial years, the yields of the fertilized variants are higher than that of the control (tab. A). It is remarkable that the 500-kg fertilizer variants achieved better results than the 1000-kg variants.

Table A: average yields (1996 - 1998) in kg/ha

	Yield kg/ha	rel. %
Biosol 500 kg/ha	9250	113
Biosol 1000 kg/ha	8834	108
Bactosol 500 kg/ha	9193	112
Bactosol 1000 kg/ha	8510	104
Control (conventional)	8207	100

The determination of the average weight of single grapes in grams per grape indicates the reason for the different yields. Optimum vine nutrition during the demand peaks has produced higher grape weights in the treated variants. This went together with a better water holding capacity of the soil and probably caused the continuously better vine supply.

Practically no differences have been found with regard to the must graduation and acid value of must. (Tab. B)

Table B: must graduation in ° KMW (weight percentage of sugar) and acid value of the grape must in g/l:

	Sugar ° KMW	Acid g/l
Biosol 500 kg/ha	17.3	8.9
Biosol 1000 kg/ha	17.3	8.9
Bactosol 500 kg/ha	17.2	9.0
Bactosol 1000 kg/ha	17.2	8.9
Control	17.2	8.9

In order to take also the quality into consideration in addition to the yield, the sugar yield (= 100 kg of grapes x ° KMW) was calculated per hectare. (Tab. C)

Table C: sugar yield in kg/ha (1996 - 1998)

	° kg/ha	rel. %
Biosol 500 kg/ha	1586	113
Biosol 1000 kg/ha	1519	108
Bactosol 500 kg/ha	1585	113
Bactosol 1000 kg/ha	1443	103
Control	1406	100

As there were hardly any differences in the must values, a similar distribution of performance resulted as for the yield table.

The positive effect of fertilizers on soils with poor nutrient supply is generally known. Such soils are hardly found in vine growing due to fertilization during the last decades. In the present trial, the soil properties were ideal for the cultivation of vines (good humus and nutrient supply). Nevertheless, due to the application of Biosol and Bactosol, a yield stability as compared to the control was determined, as well as an increase of performance. The low application rate lead to seasonal nitrogen deficiency in particular under difficult absorption conditions (aridity, hardly any mineralization ...) for nutrients as was the case in 1997. In order to avoid this and achieve an ideal vine development in the period of highest nutrient demand (early summer), a specific supplementary application of nitrogen would have been advantageous.

Results of Leaf Analyses 1998

The nutritional level of the vines with reference to the individual test variants was determined for 1998 as for the 3 previous years of 1995, 1996, and 1997. Samples of leaves were also taken on three different dates: on June 23 (blossom-time), on August 20 (softening of grapes), and on September 24, 1998 (just before vintage). The three dates can be directly compared to those of 1997.

The concentrations (%) of K, Mg, Ca, P, and N in the dry substance of the leaf blades can be seen in table 26. There were clear differences in content depending on the date of leaf sampling. The content of P and N is reduced considerably with increasing age of the leaves and progressing vegetation from the flowering period until immediately before vintage.

At the first date of leaf analysis, the Biosol variant (1000 kg/ha) had the highest N content of 3.06 %. At all sampling dates, the control variant had clearly lower N concentrations in the leaves. The mean value of 1.75 % N already lies below the required optimum range of 2.25 - 2.75 % N, and the P values are also reduced during the course of the vegetative period. The mean value determined from the 3 sampling dates indicates a suboptimum supply of the vines with P. The same signs are apparent for the K concentrations.

The Mg content is sufficient in all cases, but it is always lower in the control variant than in the treated variants. The Ca supply of the vines causes no problem in the present trial.

With regard to trace elements (table 27), the contents of Fe and Mn were found to be in the optimum range. The differences between the trial variants are relatively small. The Zn supply of the vines is insufficient in all variants; the Zn values are considerably below the optimum range of 25 - 60 ppm.

The increased Cu contents are clearly due to the final spraying with this element. The Cu values determined at the first leaf sampling date are within the normal range and there are no pronounced differences between the trial variants. As in the previous years, the results of the leaf analysis are represented graphically in figures 1 to 9.

Summary and Conclusions Drawn from Leaf Analyses (1995 - 1998)

A competent and adjusted nutrient supply of the soil is a prerequisite for environmentally safe, ecological and quality-orientated vine growing. The increasing extensification of the soil conservation in the last years, the increased introduction of greening, with no mineral fertilization may cause stress situations in the vines. The nutrients extracted by the vines have to be replaced by all means. This applies in particular to nitrogen, with an application of about 40 - 50 kg N/ha and year being sufficient in general. The negative effect of a N deficiency on the quality of the wine has been frequently discussed lately. The occurrence of the so-called "untypical ageing tone" is often connected to stress regarding water and N. The positive effect of Biosol and Bactosol on the N content of leaves and therefore on the supply of vines is revealed by the results of the 4 trial years (tab. 28 and 29).

The N content of leaves decreased from year to year due to the extensification indicated. Whereas the N content was equally high (about 2.6 % N) in all variants at the start of the trial (1995), it was reduced to about 2 % in the treated variants in 1998. This N decrease was particularly pronounced in the control variant (from 2.6 % to 1.7 %), that is more than 30 %. It can be assumed that the grapes of this variant contain less N than the treated variants. It is noteworthy that the nitrogen contents in the control variant are lower - on average over the years - than those of the treated variants, therefore they reflect the changes of nitrogen values in the soil.

The K content was also constantly reduced during the course of the trial years. At the beginning of the trial, the leaves of all variants had K values of about 1.3 %. In the year of the report (1998), they were only 1 %, which is below the optimum range of 1.2 - 1.4 % K in the leaves. Also in this case, the K quantities extracted by the vines have to be replaced to ensure the quality of the grapes. N, in particular in the form of amino acids, as well as K are decisive factors for the quality of the final product.

Table 1. Sum of Buds that have been cut

REPLICATES

Variants	A	B	C	D	E	sum	mean value	standard deviation	coefficient of variation
1 BIOSOL 500 kg/ha	18,2	18,4	16,6	17,0	17,4	87,6	17,520	0,769	4,39 %
2 BIOSOL 1000 kg/ha	17,0	17,4	18,0	16,6	17,2	86,2	17,240	0,518	3,00 %
3 BACTOSOL 500 kg/ha	18,2	18,0	17,2	17,0	17,6	88,0	17,600	0,510	2,90 %
4 BACTOSOL 1000 kg/ha	17,8	17,6	13,6	13,6	17,4	84,2	16,840	1,819	10,80 %
5 Control	18,0	17,0	16,5	16,5	17,0	86,7	17,340	0,727	4,19 %
total sum						432,7			
total mean value							17,308		

degrees of freedom

SQR = 19,824
 SQA = 1,774
 SQT = 21,598
 test size f 0,448
 F-value 2,866

mean sum of squares
 0,991
 0,444

assumption of the null hypothesis



Table 2: Sum of Sprouted Buds

REPLICATES

Variants	A	B	C	D	E	sum	mean value	standard deviation	coefficient of variation
1 BIOSOL 500 kg/ha	15,2	16,0	16,0	14,8	15,6	77,6	15,520	0,522	3,36 %
2 BIOSOL 1000 kg/ha	13,0	16,2	16,4	15,0	14,8	75,4	15,080	1,361	9,02 %
3 BACTOSOL 500 kg/ha	16,8	15,6	15,8	15,4	15,8	79,4	15,880	0,540	3,40 %
4 BACTOSOL 1000 kg/ha	16,4	15,8	16,4	11,4	15,0	75,0	15,000	2,093	13,95 %
5 Control	16,2	16,0	16,0	14,2	15,0	77,4	15,480	0,856	5,53 %
total sum						384,8			
total mean value							15,392		

SQR =	30,112	degrees of freedom	mean sum of squares
SQA =	2,566	20	1,506
SQT =	32,678	4	0,642
test size f	0,426	24	
F-value	2,866		

assumption of the null hypothesis

Table 3: Frost damage in Percent

REPLICATES

Variants	A	B	C	D	E	sum	mean value	standard deviation	coefficient of variation
1 BIOSOL 500 kg/ha	16,7	13,1	3,5	12,7	10,3	56,3	11,260	4,904	43,55 %
2 BIOSOL 1000 kg/ha	22,5	7,1	8,9	8,7	13,9	61,1	12,220	6,287	51,45 %
3 BACTOSOL 500 kg/ha	7,7	13,2	8	9,5	10,4	48,8	9,760	2,217	22,71 %
4 BACTOSOL 1000 kg/ha	7,9	10,1	7,9	16,1	13,7	55,7	11,140	3,648	32,75 %
5 Control	9,9	5,9	11,8	14,3	11,8	53,7	10,740	3,125	29,09 %
total sum						275,6			
total mean value							11,024		

SQR =	366,256	degrees of freedom	mean sum of squares
SQA =	15,890	20	18,313
SQT =	382,146	4	3,972
test size f	0,217	24	
F-value	2,866		

assumption of the null hypothesis

Table 4: Other Losses of Buds in Percent

REPLICATES

Variants	A	B	C	D	E	sum	mean value	standard deviation	coefficient of variation
1 BIOSOL 500 kg/ha	9,0	4,6	6,6	5,0	7,3	32,5	6,500	1,786	27,48 %
2 BIOSOL 1000 kg/ha	5,8	4,9	4,6	8,4	5,1	28,8	5,760	1,540	26,74 %
3 BACTOSOL 500 kg/ha	5,2	10,3	9,2	7,1	10,8	42,6	8,520	2,338	27,44 %
4 BACTOSOL 1000 kg/ha	8,2	7,0	8,2	3,3	4,0	30,7	6,140	2,338	38,08 %
5 Control	9,5	2,4	2,3	2,7	9,2	26,1	5,220	3,775	72,31 %
total sum						160,7			
total mean value							6,428		

SQR =	122,980	degrees of freedom	20	mean sum of squares	6,149
SQA =	31,850		4		7,963
SQT =	154,830		24		
test size f	1,295				
F-value	2,866				

assumption of the null hypothesis

Table 5: Wood Weights 1998 in kg/m²

REPLICATES

Variants	A	B	C	D	E	sum	mean value	standard deviation	coefficient of variation
1 BIOSOL 500 kg/ha	0,185	0,222	0,203	0,171	0,250	1,0	0,206	0,031	15,08 %
2 BIOSOL 1000 kg/ha	0,238	0,231	0,188	0,240	0,313	1,2	0,242	0,045	18,59 %
3 BACTOSOL 500 kg/ha	0,192	0,250	0,162	0,231	0,255	1,1	0,218	0,040	18,31 %
4 BACTOSOL 1000 kg/ha	0,167	0,182	0,181	0,169	0,255	1,0	0,191	0,037	19,14 %
5 Control	0,198	0,220	0,179	0,203	0,278	1,1	0,216	0,038	17,54 %
total sum						5,4			
total mean value							0,215		

SQR =	0,029	degrees of freedom	20	mean sum of squares	0,001
SQA =	0,007		4		0,002
SQT =	0,036		24		
test size f	1,191				
F-value	2,866				

assumption of the null hypothesis

Table 6: Observation of Sprouting 1998 – Kreindlhof

Observations werde made and valuated according to the BBCH scheme:

Date	Stage	Description	
May 04	13-14	foliation	3-4 leaves unfolded
May 06	14-15	foliation	4-5 leaves unfolded
May 08	16	foliation	6 leaves unfolded
May 11	17-18	foliation	7-8 leaves unfolded
May 13	18	foliaton	8 leaves unfolded

As compared to 1997, sprouting is ahead by a few days.

Table 7: Average Number of Young Sprouts/Vine

REPLICATES

Variants	A	B	C	D	E	sum	mean value	standard deviation	coefficient of variation
1 BIOSOL 500 kg/ha	16,6	17,2	17,4	15,0	15,8	82,0	16,400	1,000	6,10 %
2 BIOSOL 1000 kg/ha	14,0	16,6	16,4	15,6	15,8	78,4	15,680	1,026	6,54 %
3 BACTOSOL 500 kg/ha	17,2	16,0	15,2	15,8	16,0	80,2	16,040	0,727	4,53 %
4 BACTOSOL 1000 kg/ha	16,6	16,2	15,6	11,4	15,2	75,0	15,000	2,083	13,89 %
5 Control	16,4	16,6	17,6	14,2	15,2	80,0	16,000	1,319	8,24 %
total sum						395,6			
total mean value							15,824		

SQR =	34,640	degrees of freedom	mean sum of squares
SQA =	5,546	20	1,732
SQT =	40,186	4	1,386
test size f	0,800	24	
F-value	2,866		

assumption of the null hypothesis

Table 8: Total of Flower Clusters/Vine

REPLICATES

Variants	A	B	C	D	E	sum	mean value	standard deviation	coefficient of variation
1 BIOSOL 500 kg/ha	24,2	29,2	23,8	24,8	26,6	128,6	25,720	2,221	8,63 %
2 BIOSOL 1000 kg/ha	19,4	27,2	24,8	22,2	27,4	121,0	24,200	3,415	14,11 %
3 BACTOSOL 500 kg/ha	24,5	27,6	22,0	24,0	23,0	122,0	24,400	2,186	8,96 %
4 BACTOSOL 1000 kg/ha	27,4	27,6	26,0	14,4	23,0	118,4	23,680	5,504	23,24 %
5 Control	26,0	28,6	29,8	23,2	25,8	133,4	26,680	2,587	9,70 %
total sum						623,4			
total mean value							24,936		

SQR =	233,424	degrees of freedom	mean sum of squares
SQA =	30,314	20	11,671
SQT =	263,738	4	7,578
test size f	0,649	24	
F-value	2,866		

assumption of the null hypothesis

Table 9: Flower Clusters/Young Sprout 1998

REPLICATES

Variants	A	B	C	D	E	sum	mean value	standard deviation	coefficient of variation
1 BIOSOL 500 kg/ha	1,5	1,7	1,4	1,6	1,7	7,9	1,580	0,130	8,25 %
2 BIOSOL 1000 kg/ha	1,4	1,6	1,5	1,4	1,7	7,6	1,520	0,130	8,58 %
3 BACTOSOL 500 kg/ha	1,5	1,7	1,4	1,5	1,4	7,5	1,500	0,122	8,16 %
4 BACTOSOL 1000 kg/ha	1,7	1,7	1,7	1,3	1,5	7,9	1,580	0,179	11,32 %
5 Control	1,6	1,7	1,7	1,6	1,7	8,3	1,660	0,055	3,30 %
total sum						39,2			
total mean value							1,568		

SQR =	0,336	degrees of freedom	mean sum of squares
SQA =	0,078	20	0,017
SQT =	0,414	4	0,020
test size f	1,167	24	
F-value	2,866		

assumption of the null hypothesis

Table 10: Blossom Observations 1998

Code 57: flower clusters fully developed, individual blowers spread out
 Code 60: first flower caps separate from the receptacle
 Code 61: start of blossoming : 10 % of caps shed
 Code 63: pre-blossom: 30 % of caps shed

Code 65: pre-blossom: 50 % of caps shed
 Code 68: 80 % of caps shed
 Code 64: end of blossoming
 Code 70: start of fructification

location	trial/variety	variant	June 8	June 10	June 12	June 16, 1998
Kreindlhof	Biochemie trial Grüner Veltliner	A1	57-60	65	69-70	
		B2	57-60	65	69-70	
		C3	57	63-65	69-70	
		D4	57-60	65	69-70	
		E5	57	63-65	69	
		A4	57-60	63-65	69-70	
		B1	57-60	65	69-70	
		C5	57	63-65	69-70	
		D3	57	63-65	69-70	
		E2	57	63-65	69-70	
		A2	57-60	63-65	69	
		B5	57	63-65	69	
		C4	57	65	69-70	
		D1	57-60	65	69-70	
		E3	57-60	65	69-70	
		A5	57	63-65	69	
		B3	57	63-65	69-70	
		C1	57	63-65	69-70	
		D2	57	65	69-70	
		E4	57-60	65	69-70	
		A3	57-60	63-65	69-70	
		B4	57-60	65	69-70	
		C2	57-60	63-65	69-70	
		D5	57-60	65	69	
		E1	57	63-65	69	

Table 11b: Blossom Drop in %

REPLICATES

Variants	A	B	C	D	E	sum	mean value	standard deviation	coefficient of variation
1 BIOSOL 500 kg/ha	7,5	7,5	7,5	10,0	7,5	40,0	8,000	1,118	13,98 %
2 BIOSOL 1000 kg/ha	7,5	7,5	7,5	7,5	7,5	37,5	7,500	0,000	0,00 %
3 BACTOSOL 500 kg/ha	7,5	10,0	7,5	12,5	10,0	47,5	9,500	2,092	22,02 %
4 BACTOSOL 1000 kg/ha	10,0	10,0	7,5	10,0	12,5	50,0	10,000	1,768	17,68 %
5 Control	7,5	10,0	10,0	10,0	10,0	47,5	9,500	1,118	11,77 %
total sum						222,5			
total mean value							8,900		

SQR =	40,000	degrees of freedom	mean sum of squares
SQA =	23,500	20	2,000
SQT =	63,500	4	5,875
test size f	2,938	24	
F-value	2,866		

assumption of the null hypothesis

Table 12: Summer sampling of the soil on Aug. 3, 1998 at the time of maximum N demand: N-min values in the top soil in mg/100 g of soil

Variant	Nmin-NO ₃	Nmin-NH ₄	sum
1 BIOSOL 500 kg/ha	< 0,2	0,3	0,3 mg N/100 g
2 BIOSOL 1000 kg/ha	0,4	0,3	0,5
3 BACTOSOL 500 kg/ha	< 0,2	0,2	0,4
4 BACTOSOL 1000 kg/ha	1,0	0,2	1,3
5 Control	< 0,2	0,4	0,3

Table 13: N-min-values in the subsoil (Aug. 3, 1998): in mg/100 g of fine earth:

Variant	Nmin-NO ₃	Nmin-NH ₄	sum
1 BIOSOL 500 kg/ha	< 0,2	< 0,1	0,30
2 BIOSOL 1000 kg/ha	0,4	< 0,1	0,50
3 BACTOSOL 500 kg/ha	0,2	< 0,1	0,40
4 BACTOSOL 1000 kg/ha	0,9	< 0,1	1,30
5 Control	< 0,2	< 0,1	0,30

Table 14: N-min determination: total values from top soil and subsoil (sampling Aug. 3, 1998)

Variant	kg N/ha	Rel % to control
1 BIOSOL 500 kg/ha	12	86
2 BIOSOL 1000 kg/ha	24	170
3 BACTOSOL 500 kg/ha	17	122
4 BACTOSOL 1000 kg/ha	56	400
5 Control	14	100

**Table 15: N-min determinations in autumn in the top soil: mg/100 g of soil
Sampling: Nov. 3, 1998**

Variant	Nmin-NO ₃	Nmin-NH ₄	sum
1 BIOSOL 500 kg/ha	< 0,2	< 0,1	0,00
2 BIOSOL 1000 kg/ha	< 0,2	< 0,1	0,00
3 BACTOSOL 500 kg/ha	< 0,2	< 0,1	0,00
4 BACTOSOL 1000 kg/ha	< 0,2	< 0,1	0,00
5 Control	< 0,2	< 0,1	0,00

Table 16: N-min values in the subsoil: Nov. 3, 1998

Variant	Nmin-NO ₃	Nmin-NH ₄	sum
1 BIOSOL 500 kg/ha	< 0,2	< 0,1	0,00
2 BIOSOL 1000 kg/ha	0,5	< 0,1	0,40
3 BACTOSOL 500 kg/ha	< 0,2	< 0,1	0,10
4 BACTOSOL 1000 kg/ha	0,6	< 0,1	0,40
5 Control	< 0,2	< 0,1	0,00

Table 17: N-min determination, total values from top soil and subsoil sampling: Nov. 3, 1998

Variant	kg N/ha	Rel % to control
1 BIOSOL 500 kg/ha	0	0
2 BIOSOL 1000 kg/ha	19	1900
3 BACTOSOL 500 kg/ha	4	400
4 BACTOSOL 1000 kg/ha	19	1900
5 Control	1	100

Table 18: Sugar increase during ripening (°KMW = Klosterneuburg must value)

Variant		18.8.	27.8.	1.9.	15.9.	22.9.	29.9.98
1	BIOSOL 500 kg/ha	9,9	13,5	13,7	15,8	16,4	18,3
2	BIOSOL 1000 kg/ha	9,7	13,3	14,1	15,4	17,1	19,0
3	BACTOSOL 500 kg/ha	9,7	13,7	14,1	15,6	16,7	17,9
4	BACTOSOL 1000 kg/ha	10,7	13,5	14,3	15,6	16,9	18,5
5	Control	9,7	12,9	14,4	16,0	17,1	19,0

Table 19: Acid development during ripening (%)

Variant		18.8.	27.8.	1.9.	15.9.	22.9.	29.9.98
1	BIOSOL 500 kg/ha	25,6	13,9	11,6	7,9	7,9	7,8
2	BIOSOL 1000 kg/ha	27,0	13,4	10,6	8,2	7,8	7,6
3	BACTOSOL 500 kg/ha	27,6	13,1	11,6	8,3	8,1	7,9
4	BACTOSOL 1000 kg/ha	22,6	13,0	10,7	7,9	8,2	8,1
5	Control	28,2	13,9	10,9	8,3	8,5	8,2

Table 20: Results of preliminary samples before ripening 1998 and comparison with the previous year 1997

KMW = Klosterneuburg must value °Oe = Oechsle degrees

Variant		KMW	18.08.1998 °Oe	‰ acid
1	BIOSOL 500 kg/ha	9,9	47	25,6
2	BIOSOL 1000 kg/ha	9,7	46	27,0
3	BACTOSOL 500 kg/ha	9,7	46	27,6
4	BACTOSOL 1000 kg/ha	10,7	51	22,6
5	Control	9,7	46	28,2

Variant		27.08.1997			27.08.1998		
		°KMW	°Oe	‰ acid	°KMW	°Oe	‰ acid
1	BIOSOL 500 kg/ha	9,9	47	22,8	13,5	65	13,9
2	BIOSOL 1000 kg/ha	9,1	43	25,2	13,3	64	13,4
3	BACTOSOL 500 kg/ha	9,5	45	23,4	13,7	66	13,1
4	BACTOSOL 1000 kg/ha	9,7	46	23,2	13,5	65	13,0
5	Control	9,7	44	23,0	12,9	62	13,9

Variant		03.09.1997			01.09.1998		
		°KMW	°Oe	%o acid	°KMW	°Oe	%o acid
1	BIOSOL 500 kg/ha	11,9	57	16,4	13,7	66	11,6
2	BIOSOL 1000 kg/ha	12,5	60	16,2	14,1	68	10,8
3	BACTOSOL 500 kg/ha	12,9	62	15,2	14,1	68	11,6
4	BACTOSOL 1000 kg/ha	12,7	61	16,0	14,3	69	10,7
5	Control	12,3	59	16,2	14,4	70	10,9

Variant		17.09.1997			15.09.1998		
		°KMW	°Oe	%o acid	°KMW	°Oe	%o acid
1	BIOSOL 500 kg/ha	15,6	76	9,2	15,8	77	7,9
2	BIOSOL 1000 kg/ha	16,0	78	9,6	15,4	75	8,2
3	BACTOSOL 500 kg/ha	15,6	76	9,6	15,6	76	8,3
4	BACTOSOL 1000 kg/ha	15,8	77	9,4	15,6	76	7,9
5	Control	15,2	74	9,5	16,0	78	8,3

Variant		24.09.1997			22.09.1998		
		°KMW	°Oe	%o acid	°KMW	°Oe	%o acid
1	BIOSOL 500 kg/ha	16,6	81	8,2	16,4	80	7,9
2	BIOSOL 1000 kg/ha	16,9	83	8,2	17,1	84	7,8
3	BACTOSOL 500 kg/ha	16,6	81	8,1	16,7	82	8,1
4	BACTOSOL 1000 kg/ha	17,0	83	8,4	16,9	83	8,2
5	Control	16,6	81	8,4	17,1	84	8,5

Variant		01.10.1997			29.09.1998		
		°KMW	°Oe	%o acid	°KMW	°Oe	%o acid
1	BIOSOL 500 kg/ha	17,6	86	7,7	18,3	90	7,8
2	BIOSOL 1000 kg/ha	17,9	88	7,7	19,0	94	7,6
3	BACTOSOL 500 kg/ha	17,9	88	7,1	17,9	88	7,9
4	BACTOSOL 1000 kg/ha	18,1	89	7,2	18,5	91	8,1
5	Control	17,7	87	7,5	19,0	94	8,2

Table 21: Yield in kg/m²

REPLICATES

Variants	A	B	C	D	E	sum	mean value	standard deviation	coefficient of variation
1 BIOSOL 500 kg/ha	0,681	0,883	0,857	0,786	0,547	3,8	0,751	0,138	18,41 %
2 BIOSOL 1000 kg/ha	0,659	0,831	0,882	0,629	0,690	3,7	0,738	0,112	15,12 %
3 BACTOSOL 500 kg/ha	0,603	0,644	0,653	1,085	0,604	3,6	0,718	0,207	28,77 %
4 BACTOSOL 1000 kg/ha	0,832	0,647	0,639	0,634	0,854	3,6	0,721	0,112	15,47 %
5 Control	0,585	0,593	0,855	0,676	0,551	3,3	0,652	0,122	18,78 %
total sum						17,9			
total mean value							0,716		

SQR =	0,407	degrees of freedom	20	mean sum of squares	0,020
SQA =	0,029		4		0,007
SQT =	0,436		24		
test size f	0,359				
F-value	2,866				

assumption of the null hypothesis

Table 22: Average Weight of Grapes in Grams/Grape

REPLICATES

Variants	A	B	C	D	E	sum	mean value	standard deviation	coefficient of variation
1 BIOSOL 500 kg/ha	232	235	191	204	181	1043,0	208,600	24,172	11,59 %
2 BIOSOL 1000 kg/ha	197	220	231	192	207	1047,0	209,400	16,134	7,70 %
3 BACTOSOL 500 kg/ha	207	205	207	234	188	1041,0	208,200	16,438	7,92 %
4 BACTOSOL 1000 kg/ha	226	197	209	188	217	1037,0	207,400	15,209	7,33 %
5 Control	177	213	173	186	149	898,0	179,600	23,147	12,89 %
total sum						5066,0			
total mean value							202,640		

SQR =	7533,600	degrees of freedom	mean sum of squares
SQA =	3328,160	20	376,680
SQT =	10861,760	4	832,040
test size f	2,209	24	
F-value	2,866		

assumption of the null hypothesis

Table 23: Average Number of Grapes/Vine

REPLICATES

Variants	A	B	C	D	E	sum	mean value	standard deviation	coefficient of variation
1 BIOSOL 500 kg/ha	10,6	13,5	16,2	13,8	10,9	65,0	13,000	2,308	17,75 %
2 BIOSOL 1000 kg/ha	12,1	13,6	13,8	11,8	12,0	63,3	12,660	0,958	7,57 %
3 BACTOSOL 500 kg/ha	10,5	11,3	11,3	16,7	11,6	61,4	12,280	2,504	20,39 %
4 BACTOSOL 1000 kg/ha	13,3	11,8	11,0	10,2	14,2	60,5	12,100	1,640	13,55 %
5 Control	11,9	10,0	17,8	13,1	13,3	66,1	13,220	2,877	21,76 %
total sum						316,3			
total mean value							12,652		

SQR = 93,928

SQA = 4,434

SQT = 98,362

test size f 0,236

F-value 2,866

degrees of freedom

20

4

24

mean sum of squares

4,696

1,109

assumption of the null hypothesis

Results of Leaf Analyses 1998

Table 26: Content of K, Mg, Ca, P, and N in the Leaf Blades

test variant	sampling date			mean value	optimum range
	23.06.1998	20.08.1998	24.09.1998		

Potassium %

Biosol 500 kg/ha	1,11	0,81	1,01	0,98	1,2 – 1,4 % K
Biosol 1000 kg/ha	1,15	0,98	1,07	1,06	
Bactosol 500 kg/ha	1,19	0,89	1,09	1,06	
Bactosol 1000 kg/ha	1,09	0,89	1,01	1,00	
conventional fertilization	1,17	1,07	1,01	1,08	
mean value	1,14	0,93	1,04		
standard deviation	0,04	0,09	0,04		
coefficient of variation (%)	3,11	9,67	3,48		

Magnesium %

Biosol 500 kg/ha	0,29	0,40	0,32	0,33	0,25 – 0,50 % Mg
Biosol 1000 kg/ha	0,32	0,42	0,33	0,36	
Bactosol 500 kg/ha	0,29	0,40	0,31	0,33	
Bactosol 1000 kg/ha	0,30	0,44	0,34	0,36	
conventional fertilization	0,27	0,34	0,30	0,30	
mean value	0,29	0,40	0,32		
standard deviation	0,02	0,03	0,01		
coefficient of variation (%)	6,32	8,43	4,63		

Calcium %

Biosol 500 kg/ha	1,50	3,24	2,72	2,49	2,5 – 3,5 % Ca
Biosol 1000 kg/ha	1,62	3,13	3,13	2,63	
Bactosol 500 kg/ha	1,57	3,05	2,88	2,50	
Bactosol 1000 kg/ha	1,51	2,86	2,90	2,42	
conventional fertilization	1,76	2,75	3,19	2,56	
mean value	1,59	3,00	2,96		
standard deviation	0,09	0,18	0,17		
coefficient of variation (%)	5,85	5,95	5,81		

Phosphorus %

Biosol 500 kg/ha	0,26	0,15	0,12	0,18	0,19 – 0,24 % P
Biosol 1000 kg/ha	0,21	0,14	0,13	0,16	
Bactosol 500 kg/ha	0,19	0,13	0,12	0,15	
Bactosol 1000 kg/ha	0,19	0,13	0,10	0,14	
conventional fertilization	0,18	0,15	0,14	0,16	
mean value	0,21	0,14	0,12		
standard deviation	0,03	0,01	0,01		
coefficient of variation (%)	14,66	5,69	9,91		

Nitrogen %

Biosol 500 kg/ha	2,84	1,85	1,33	2,01	2,25 – 2,75 % N
Biosol 1000 kg/ha	3,06	1,94	1,43	2,14	
Bactosol 500 kg/ha	2,65	1,89	1,29	1,94	
Bactosol 1000 kg/ha	2,78	1,98	1,47	2,08	
conventional fertilization	2,44	1,61	1,18	1,74	
mean value	2,75	1,85	1,34		
standard deviation	0,21	0,13	0,10		
coefficient of variation (%)	7,54	7,00	7,68		

Results of Leaf Analyses 1998

Table 27: Content of Fe, Cu, Zn, and Mn in the Leaf Blades

test variant	sampling date			mean value	optimum range
	23.06.1998	20.08.1998	24.09.1998		

Iron ppm

Biosol 500 kg/ha	45	120	118	94,4	100 – 1000 ppm Fe
Biosol 1000 kg/ha	68	124	116	102,8	
Bactosol 500 kg/ha	50	113	128	97,2	
Bactosol 1000 kg/ha	65	113	126	101,1	
conventional fertilization	81	105	138	108,1	
mean value	61,8	115,0	125,3		
standard deviation	12,9	6,6	8,0		
coefficient of variation (%)	20,9	5,7	6,4		

Copper ppm

Biosol 500 kg/ha	8	561	263	276,9	10 – 20 ppm Cu
Biosol 1000 kg/ha	9	611	338	319,2	
Bactosol 500 kg/ha	9	613	264	295,6	
Bactosol 1000 kg/ha	8	533	246	262,5	
conventional fertilization	7	578	362	315,3	
mean value	8,2	579,2	294,3		
standard deviation	1,0	30,4	46,2		
coefficient of variation (%)	11,9	5,2	15,7		

Zinc ppm

Biosol 500 kg/ha	17	16	15	15,8	25 – 60 ppm Zn
Biosol 1000 kg/ha	15	15	12	13,9	
Bactosol 500 kg/ha	14	13	13	13,2	
Bactosol 1000 kg/ha	10	10	18	12,5	
conventional fertilization	13	11	15	13,2	
mean value	13,7	12,9	14,5		
standard deviation	2,2	2,2	1,9		
coefficient of variation (%)	16,0	17,0	13,4		

Manganese ppm

Biosol 500 kg/ha	93	158	153	134,2	30 – 300 ppm Mn
Biosol 1000 kg/ha	113	153	145	136,7	
Bactosol 500 kg/ha	95	165	147	135,6	
Bactosol 1000 kg/ha	111	169	149	143,1	
conventional fertilization	113	183	165	153,9	
mean value	104,8	165,5	151,7		
standard deviation	9,1	10,6	7,1		
coefficient of variation (%)	8,7	6,4	4,7		

Results of Leaf Analyses (1995 – 1998)

Table 28: Nutrient Content of K, Mg, Ca, P, and N in the Leaf Blades

Test variant	mean value				
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POTASSIUM %	1995	1996	1997	1998	mean value (1995-1998)
Biosol 500 kg/ha	1,32	1,13	1,10	0,98	1,13
Biosol 1000 kg/ha	1,30	1,09	1,17	1,06	1,16
Bactosol 500 kg/ha	1,33	1,10	1,15	1,06	1,16
Bactosol 1000 kg/ha	1,28	1,08	1,15	1,00	1,12
conventional fertilization	1,33	1,11	1,23	1,09	1,19

MAGNESIUM %	1995	1996	1997	1998	mean value (1995-1998)
Biosol 500 kg/ha	0,31	0,36	0,39	0,33	0,35
Biosol 1000 kg/ha	0,32	0,37	0,40	0,36	0,36
Bactosol 500 kg/ha	0,30	0,35	0,38	0,33	0,34
Bactosol 1000 kg/ha	0,32	0,36	0,38	0,36	0,35
conventional fertilization	0,31	0,37	0,36	0,30	0,33

CALCIUM %	1995	1996	1997	1998	mean value (1995-1998)
Biosol 500 kg/ha	3,38	3,44	2,81	2,49	3,03
Biosol 1000 kg/ha	3,35	3,51	3,03	2,63	3,13
Bactosol 500 kg/ha	3,25	3,40	3,09	2,50	3,06
Bactosol 1000 kg/ha	3,18	3,30	2,75	2,42	2,91
conventional fertilization	3,48	3,55	3,10	2,56	3,17

PHOSPHORUS %	1995	1996	1997	1998	mean value (1995-1998)
Biosol 500 kg/ha	0,20	0,18	0,17	0,18	0,18
Biosol 1000 kg/ha	0,19	0,18	0,18	0,16	0,18
Bactosol 500 kg/ha	0,19	0,18	0,17	0,15	0,17
Bactosol 1000 kg/ha	0,20	0,18	0,16	0,14	0,18
conventional fertilization	0,19	0,19	0,17	0,16	0,18

NITROGEN %	1995	1996	1997	1998	mean value (1995-1998)
Biosol 500 kg/ha	2,60	2,31	2,31	2,01	2,31
Biosol 1000 kg/ha	2,62	2,43	2,37	2,14	2,39
Bactosol 500 kg/ha	2,57	2,35	2,17	1,94	2,26
Bactosol 1000 kg/ha	2,63	2,32	2,24	2,08	2,32
conventional fertilization	2,60	2,29	2,12	1,74	2,19

Results of Leaf Analyses (1995 – 1998)

Table 29: Nutrient Content of Fe, Cu, Zn, and Mn in the Leaf Blades

Test variant	mean value				
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IRON ppm	1995	1996	1997	1998	mean value (1995-1998)
Biosol 500 kg/ha	96,11	126,94	106,39	94,44	105,97
Biosol 1000 kg/ha	88,06	123,89	104,44	102,78	104,79
Bactosol 500 kg/ha	88,33	114,58	106,53	97,22	101,67
Bactosol 1000 kg/ha	82,78	114,17	105,69	101,11	100,94
conventional fertilization	80,28	122,64	107,08	108,06	104,51

COPPER ppm	1995	1996	1997	1998	mean value (1995-1998)
Biosol 500 kg/ha	234,72	211,11	230,56	276,94	283,33
Biosol 1000 kg/ha	225,83	202,78	235,97	319,17	245,94
Bactosol 500 kg/ha	215,83	185,56	246,39	295,56	235,83
Bactosol 1000 kg/ha	215,28	217,64	241,81	262,50	234,31
conventional fertilization	218,33	202,64	266,81	315,28	250,76

ZINC ppm	1995	1996	1997	1998	mean value (1995-1998)
Biosol 500 kg/ha	21,67	21,39	17,08	15,83	18,99
Biosol 1000 kg/ha	16,11	20,56	14,03	13,89	16,15
Bactosol 500 kg/ha	19,17	22,64	14,86	13,18	17,46
Bactosol 1000 kg/ha	16,11	22,78	15,69	12,50	16,77
conventional fertilization	16,11	21,81	15,56	13,21	16,67

MANGANESE ppm	1995	1996	1997	1998	mean value (1995-1998)
Biosol 500 kg/ha	115,28	173,06	148,47	134,17	142,74
Biosol 1000 kg/ha	115,56	187,64	160,14	136,67	150,00
Bactosol 500 kg/ha	114,44	178,89	156,81	135,56	146,42
Bactosol 1000 kg/ha	122,50	169,03	150,97	143,06	146,39
conventional fertilization	117,22	189,72	169,31	153,89	157,53

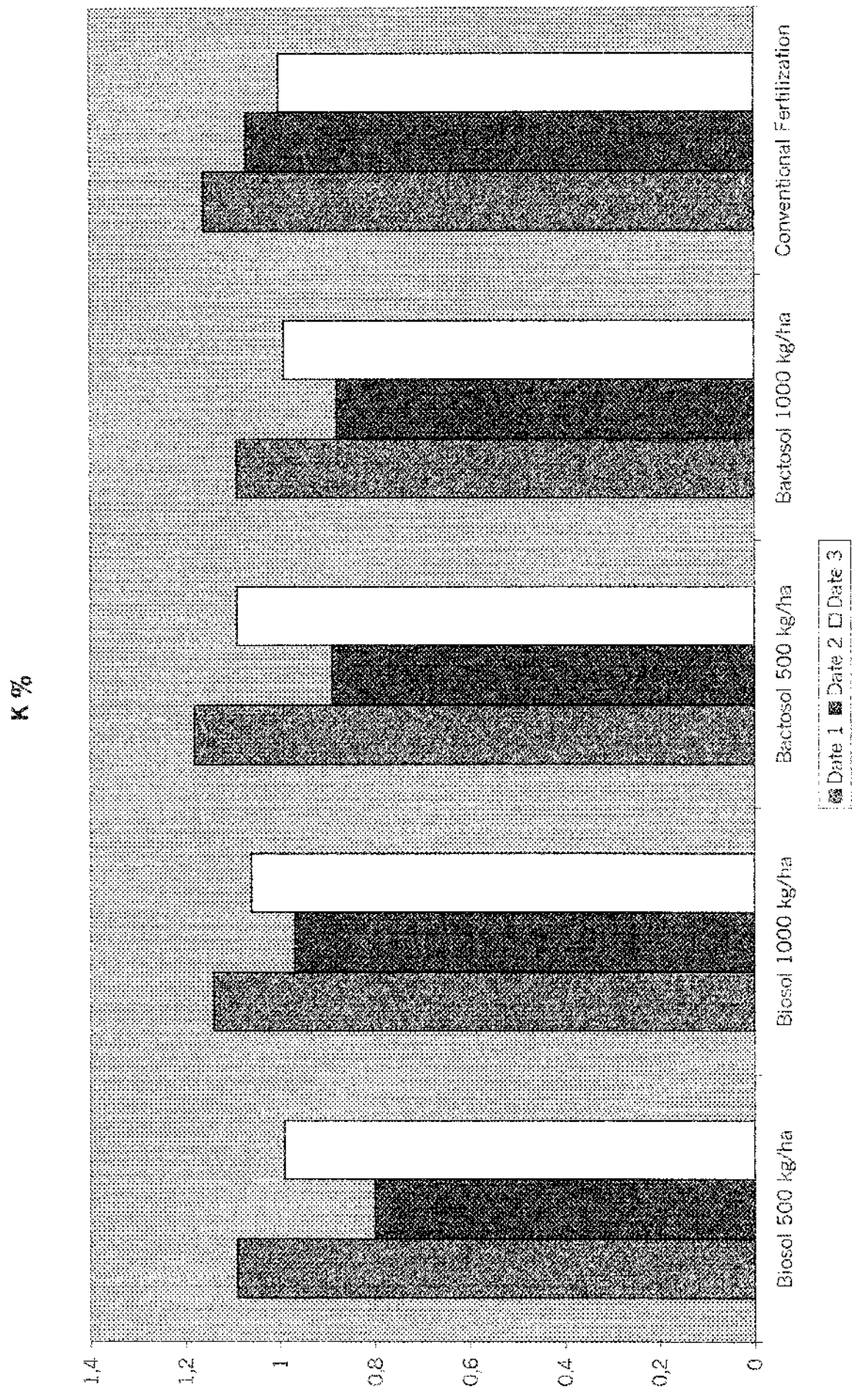


Figure 1:
K-content in the leaf blades of the variety Grünér Veltliner with reference to the test variants and sampling dates

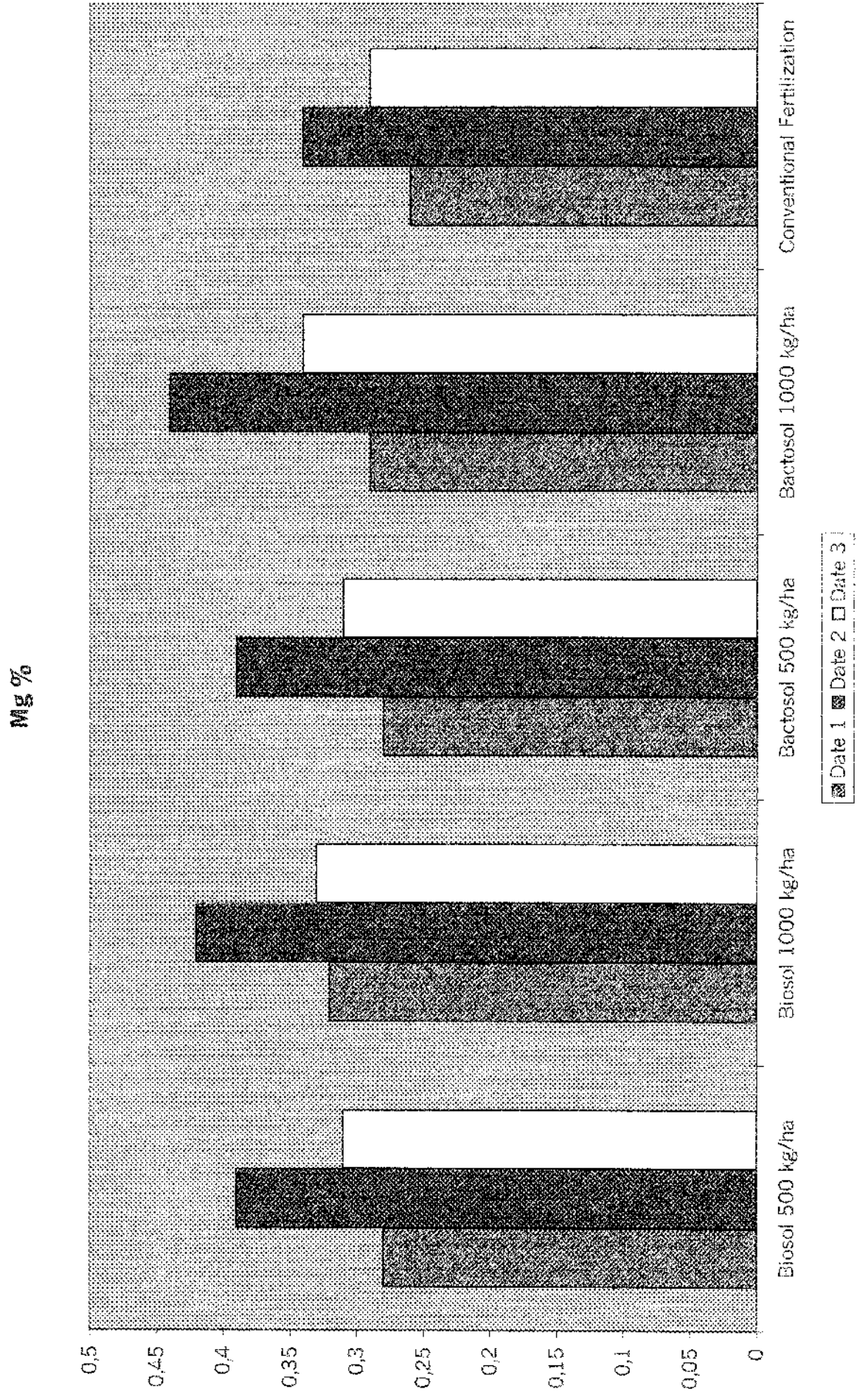


Figure 2:
Mg-Content in the leaf blades of the variety Grüner Veltliner with reference to the test variants and sampling dates

Ca %

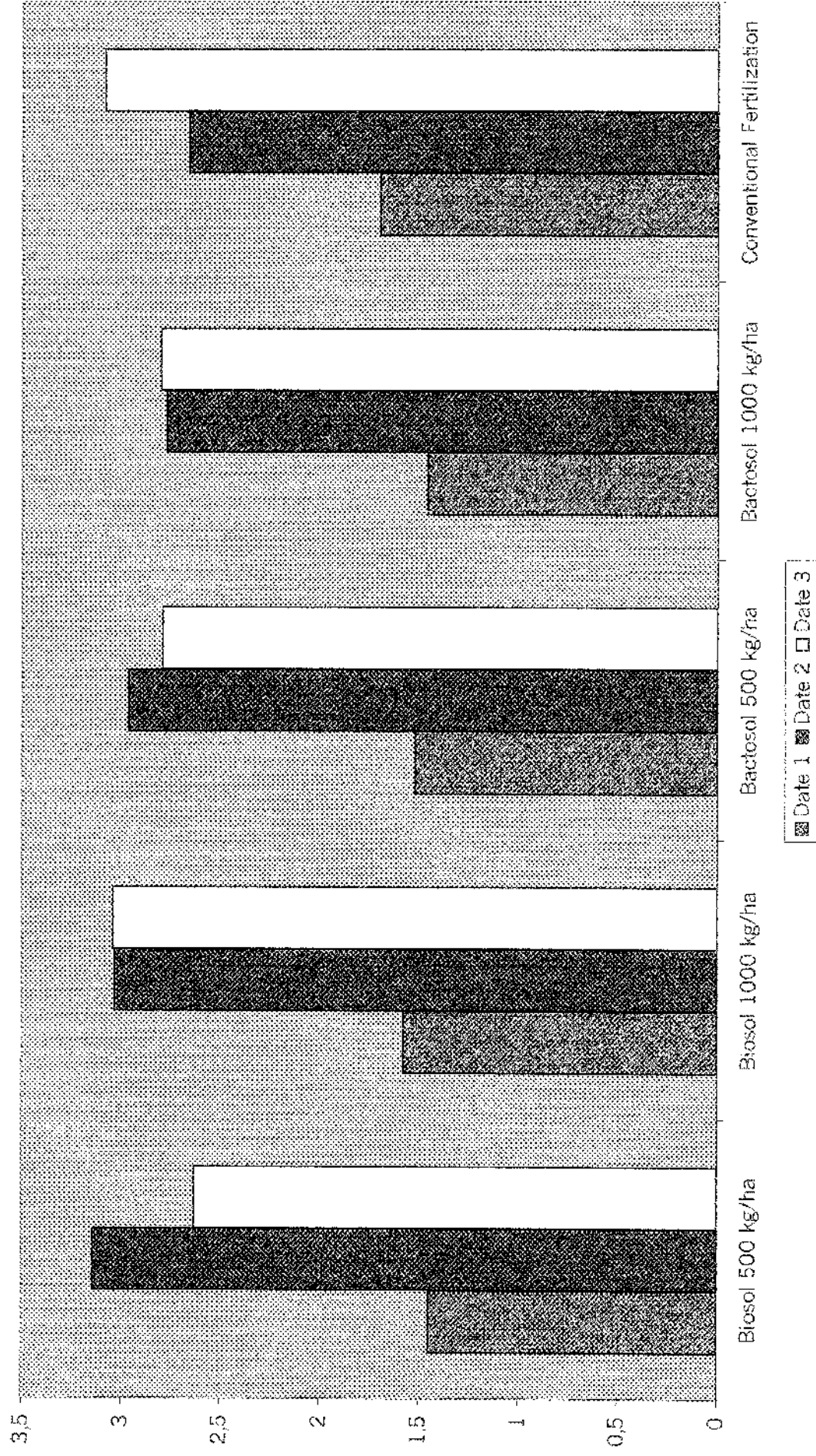


Figure 3:
Ca-content in the leaf blades of the variety Grüner Veltliner with reference to the test variants and sampling dates

P %

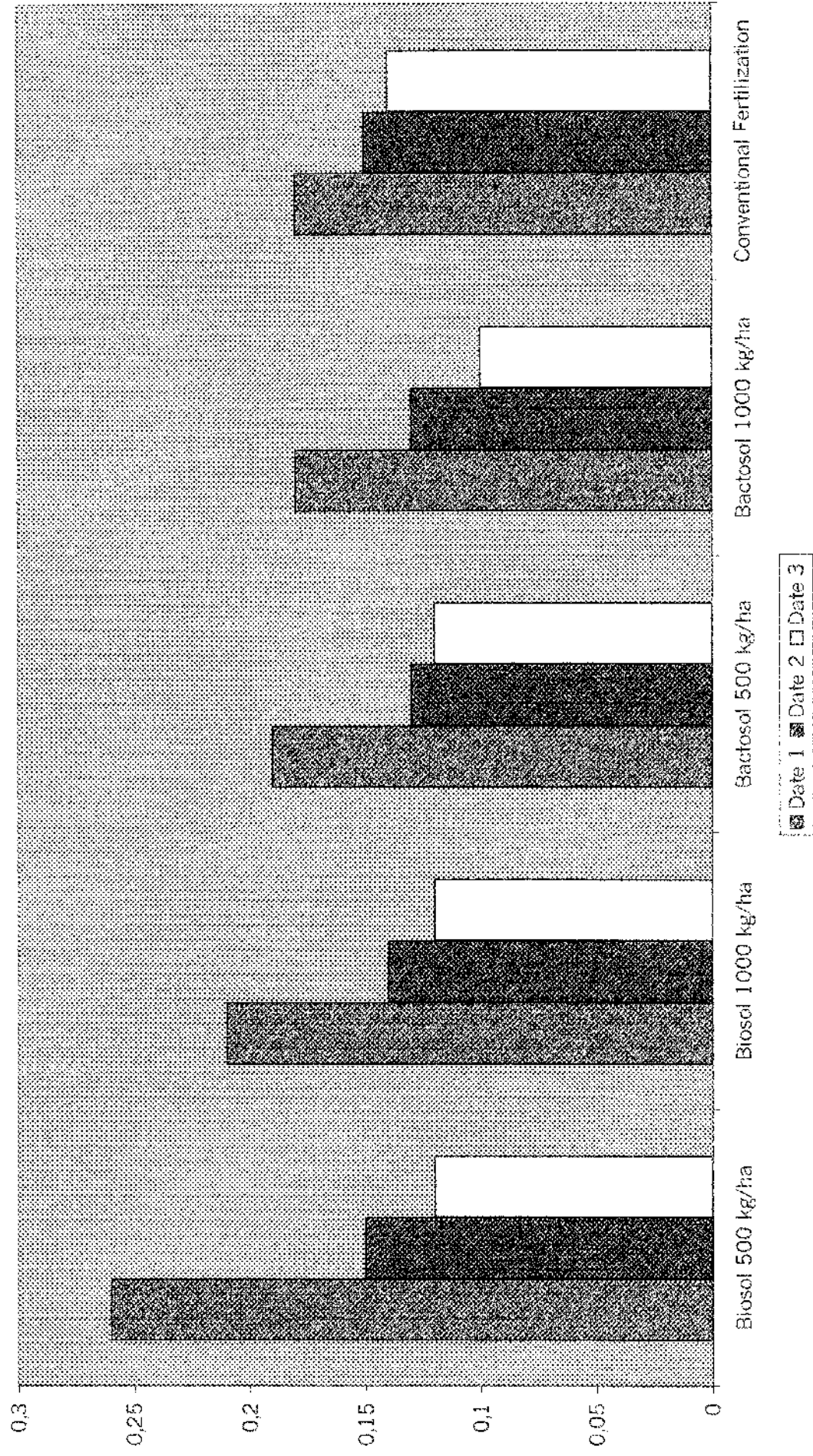


Figure 4:
P-content in the leaf blades of the variety Grünar Veltliner with reference to the test variants and sampling dates

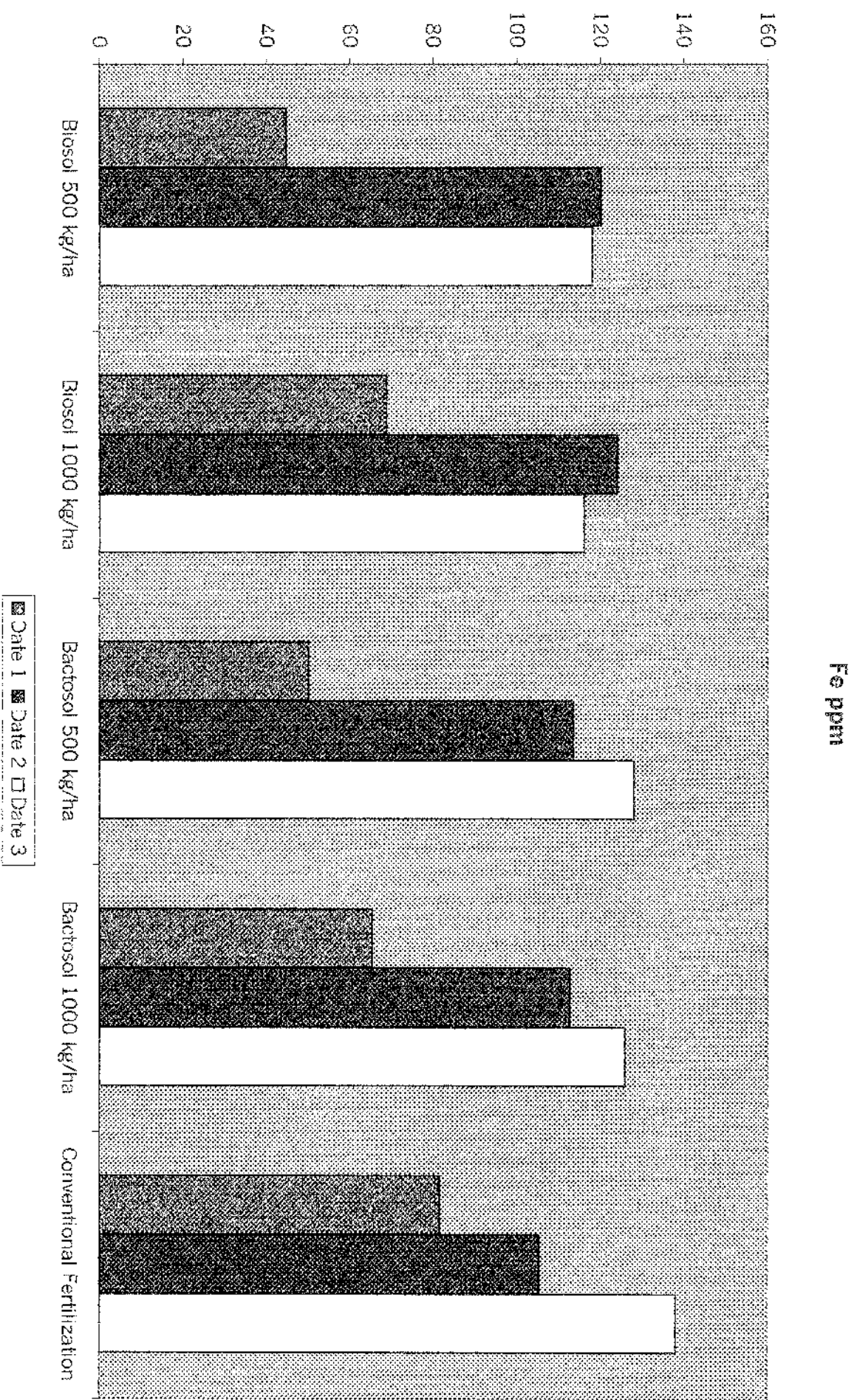


Figure 5:
Fe-content in the leaf blades of the variety Grünar Veltliner with reference to the test variants and sampling dates

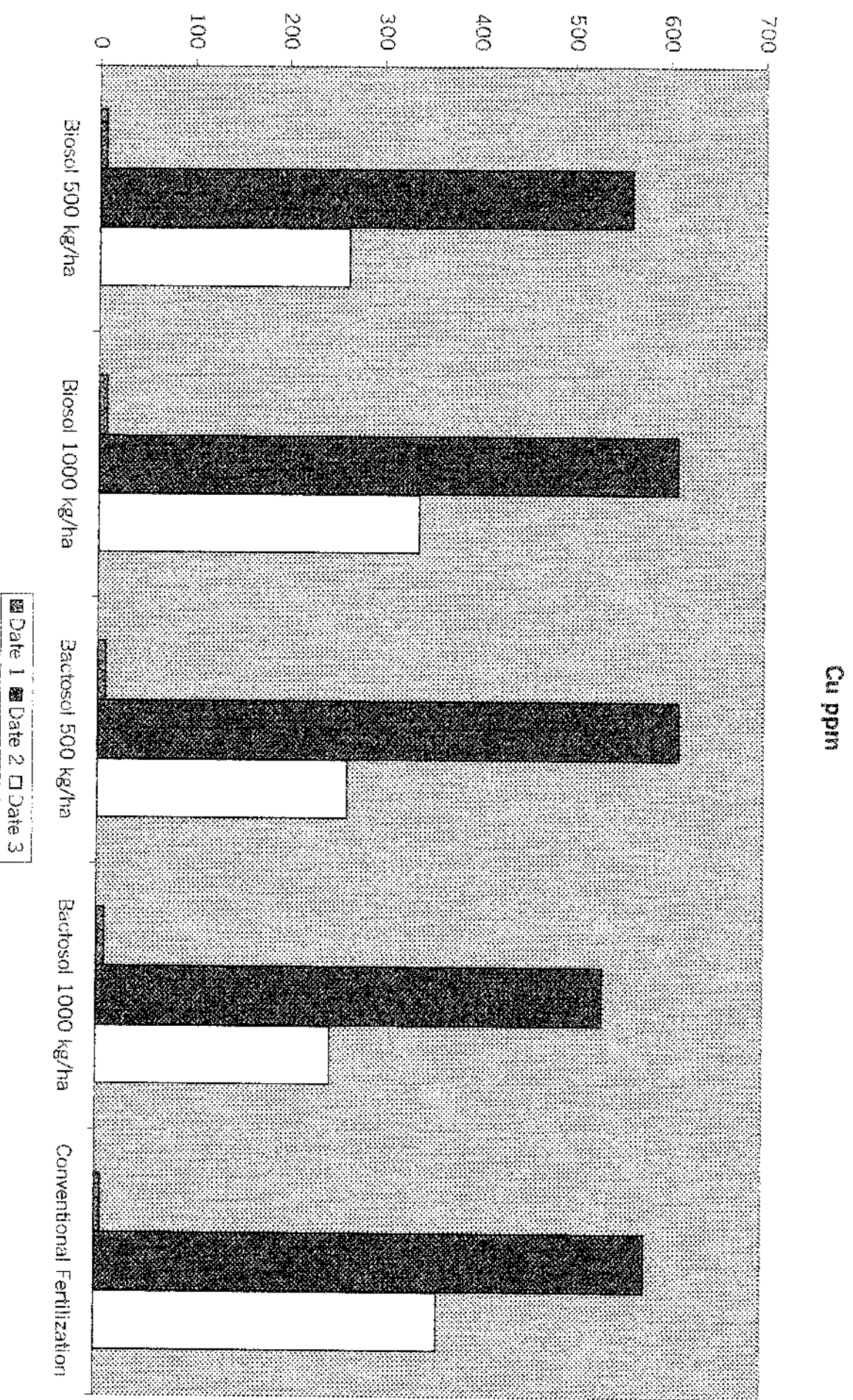


Figure 6:
Cu-content in the leaf blades of the variety Grünar Vahliner with reference to the test variants and sampling dates

Zn ppm

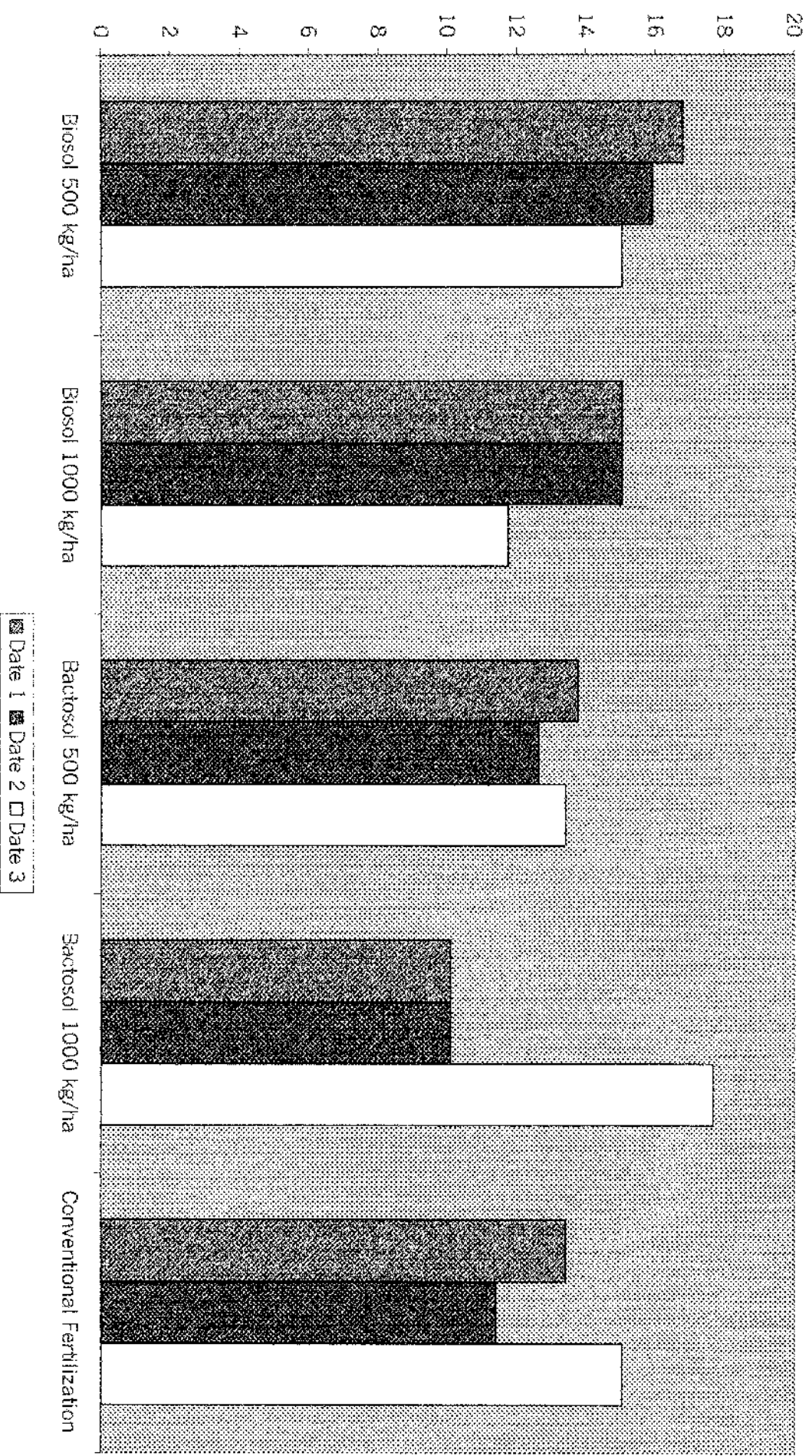


Figure 7:
Zn-content in the leaf blades of the variety Grüner Veltliner with reference to the test variants and sampling dates

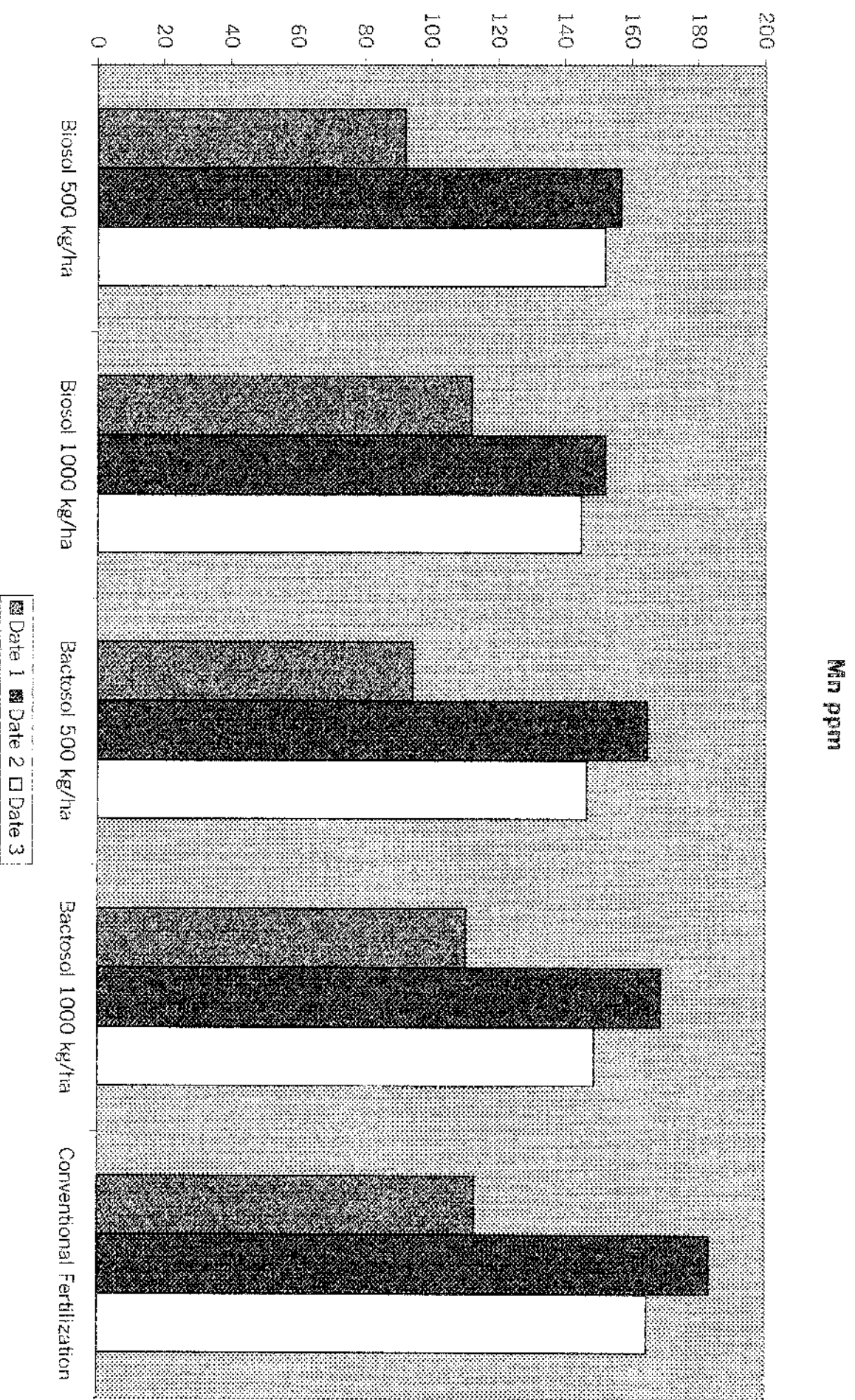


Figure 8:
Min-content in the leaf blades of the variety Gruner Veltliner with reference to the test variants and sampling dates

N %

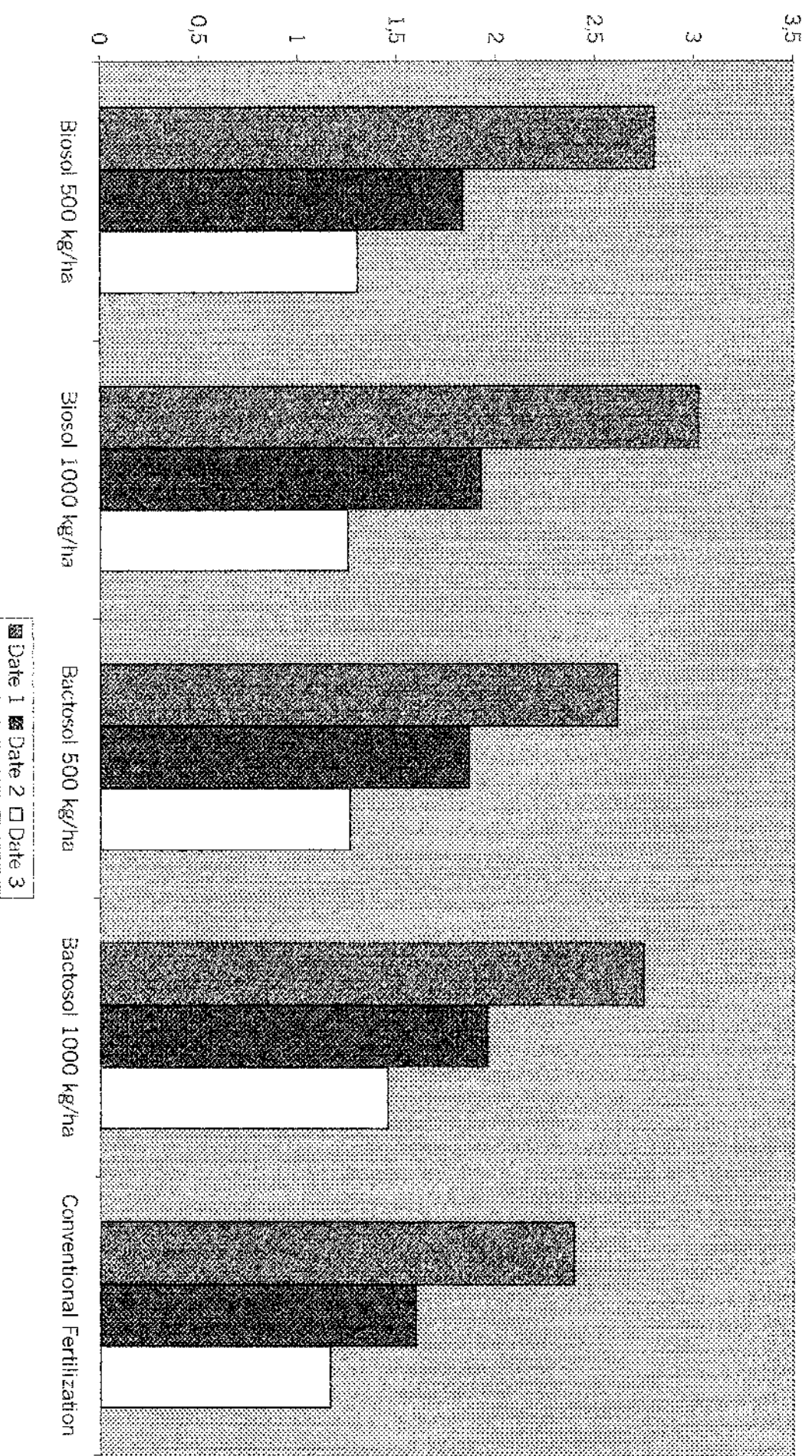


Figure 9:
N-content in the leaf blades of the variety Gruner Veltliner with reference to the test variants and sampling dates