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Contents

Plenary Session
(II) Land use in an expanding European market

Session 1.1: Agro-ecological characterization and climate change.

Session 3.2: Phosphate uptake accumulation and losses

Division 6: Agriculture-environment relationships

CHANGING LAND USE IN EUROPE : THE GLOBAL CONTEXT

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The land resource of Western Europe has proved more than adequate to meets the needs of its 350 million citizens. However, because of growing global interdependence and the demographic challenge in developing countries, future patterns of use of agricultural resources may be quite different from those of the past.

At global level, the dominant factor for at least another two generations will be population growth. While numbers have stabilised in much of the developed world, populations continue to expand at approximately two per cent per annum in developing countries. Here also, expansion in numbers must eventually cease. This global stabilisation is expected within the next century. When viewed on a long time scale, the path of world population growth presents a dramatic picture, in which almost all of the expansion occurs in a few short generations. In fact, it looks like a wall. Future generations will view it as the most important single discontinuity in human history.

Assuming an ultimate global population of around 12 billion, we are at present half way up this wall. The last (and, it is expected, final) doubling of human population will take place in the next fifty years. Providing food security through this transition, while maintaining a productive and habitable environment, constitutes the greatest challenge yet faced by humanity.

Within that broad context, there are significant additional factors : the change from largely rural to largely urban society, the changing consumption patterns which come with rising incomes, and the growing dominance of global corporations in the supply of food.

Technically, it should be possible to meet these challenges. The experience of the last few decades is encouraging: while the population in developing countries has doubled, food supply per head has increased, and the numbers and percentage of those suffering from malnutrition have declined.

IMPACT OF CLIMATE CHANGE ON CROPPING SYSTEM AND ITS IMPLICATION FOR ARGRICULTURE IN CHINA

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Introduction

With the rapid development of science and technology in the world the impact induced by human activity on the environment and on climate is getting more and more serious. The climate change arising from the enhanced emission of CO2 and other greenhouse gasses to the atmosphere can potentially change the current eco-climate environment, and futhermore, the current distribution of cropping system in China. The studies on these problems are therefore of a far more profound significance.

Methods

To estimate the regional climate change scenarios for China, seven GCMs (GFDL, GISS, LLNL, MPI, OSU, UKMO-L & UKMO-H) and derived then composite GCM have been chosen to combine with the GSECIM model (Hulme et al., 1992). Also, a special cropping pattern-climate model developed on a set of indexes of active accumulated temperature above 0°C (AAT) has been used to investigate the possible impact of climate change on cropping system in China. All changes of cropping system under current and future projected climates were calculated and mapped with 0.5 x 0.5 gridded resolution in the region from 15-60°N and 70-140°E as areal extent for China (Wang et al., 1994).

Results

The possible changes in cropping system projected by the composite GCM scenario in the year 2050 are presented in Figure 1 and Table 1. Large changes would occur almost everywhere in China. The warmer climate causes large part of the present double cropping area to be replaced by the different triple cropping patterns, while the current double cropping area would shift northward towards the central part of the present single cropping area. More explicitly, the northern boundary of triple cropping area would shift from its current border at Yangtze River towards Huanghe River, a shift of more than 5 degrees of latitudes. As a result, the current area of single cropping pattern would be reduced by about 23.1% and the triple cropping area could be extended by roughly 22.4%, while the double cropping area would almost remain the same, as likely under the current climate.

To a certain extent, such changes seem that a climate change (warming) would be favourable to agriculture of China due to a diversification and multiplication of cropping patterns. In fact, however, the area suitable for rice and wheat cultivation which are the major two crops in China would increase but mean yield would decrease due to reduced water availability, that is, the net balance between precipitation and evapotranspiration would be negative and moisture stress would be more severe than today, although precipitation in future would increase somewhat. So, the likely impacts of climate change on farm in some major regions of China would probably be unfavourable (Wang, 1995).

Table 1. The Potential Percentage Area Climate of Different Cropping Patterns for Current (1951- 1980) and the Year 2050 (%)

Cropping Patterns	Current Climate	Future Climate	Changes
Single Cropping	62.3	39.2	-23.1
Double Cropping	24.2	24.9	+0.7
Triple Cropping	13.5	35.9	+22.4

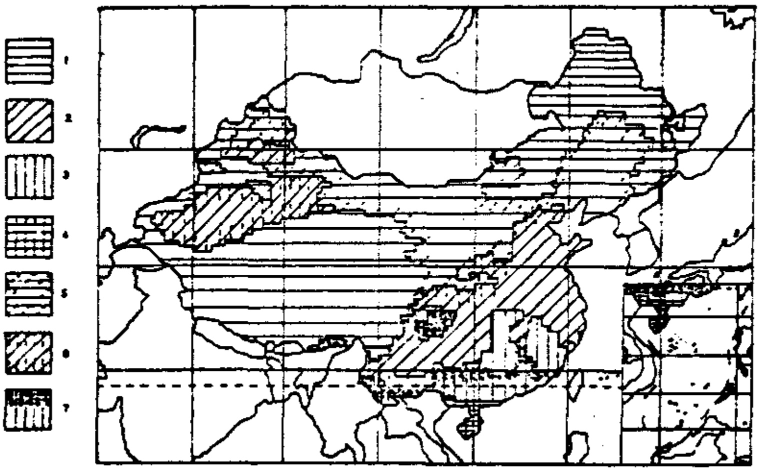

Figure 1. The distribution of cropping patterns in China under current (1951-1980) climate (nrs. 1-4) & its shifts under projected climate by composite GCM scenario for 2050 (nrs. 5-7). 1, 2, 3 & 4 represent single, double, triple & hot-triple cropping & 5, 6 &7 stand for projected double, triple & hot-triple cropping, respectively

Discussion

It is necessary to stress that both the agricultural production and impact of climate change on it are very complex and difficult problems. The former not only depends on many weather-climatic factors, but also on social and economic environments. And the latter are also various in different regions, especially for so large areal extent of China. And also, there are a lot of scientific uncertainties in the investigation of climate change, including the human activity-induced impact, natural climate at current times it is not yet to reach any conclusions (either quantitatively or qualitatively), or to be explain conclusively how will the climate change influence on agriculture in China. It must be further studied and more significant results will be expected in future.

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EFFECTS OF CO_2 AND TEMPERATURE ON GROWTH AND YIELD OF CROPS OF WINTER WHEAT OVER SEVERAL SEASONS

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Introduction

The potential impact of an increasing atmospheric CO_2 concentration ($[CO_2]$) and warmer global temperatures to crop production are substantial. Elevated $[CO_2]$ is expected to increase primary biomass production in temperate crops, however, global warming *per se* reduces crop duration in determinate cereal crops (e.g. Batts *et al.*, 1996). We have grown wheat crops in our field-based temperature gradient facility to quantify the effects of both $[CO_2]$ and temperature, and particularly the interaction between these factors, on crop biomass and grain yield in field stands of winter wheat. Four years' experimentation enables an assessment of the plasticity of yield component structures and the relative inter-annual effects of $[CO_2]$ and temperature on biomass and grain yield.

Methods

Crops of winter wheat (*Triticum aestivum* L. cv. Hereward) were grown in four consecutive seasons from 1991/92 to 1994/95 at Reading UK (51°27' N, 0°56' W), within twin-wall polythene-covered tunnels along which a near-linear gradient in temperature was superimposed on the ambient variation in temperature (Hadley *et al.*, 1995). One pair of tunnels were at normal $[CO_2]$, while another pair were elevated to *c.* 700 μmol CO_2 mol^{-1} air. Standard agronomic practices were followed, with crops irrigated to maintain soil at near field capacity (Batts *et al.*, 1996). The temperature gradient facility was relocated *c.* 20m away for the 1993/94 and 1994/95 seasons.

Results

At maturity total crop biomass decreased with mean seasonal temperature within each year and $[CO_2]$, due mainly to shorter crop durations at the warmer temperatures. Carbon dioxide doubling increased crop biomass at all temperatures in all four years (Table 1). The extent of the effect of $[CO_2]$ on biomass showed different responses with temperature; a positive interaction in 1991/92, a fixed beneficial effect in 1992/93 & 1993/94, and a negative interaction in 1994/95. Grain yield responses were greater at cooler temperatures and at elevated $[CO_2]$ in all years. The grain yield response patterns of $[CO_2]$ and temperature showed a positive interaction in 1991/92, a fixed increase in 1992/93, however in contrast, negative interactions were detected in 1993/94 & 1994/95 with the grain yield increases due to elevated $[CO_2]$ declining from *c.* 52% at cooler temperatures to

7-31% at the warmest. The yield benefits from [CO_2] doubling were negated by warming of *c.* 1-2°C above the seasonal mean (Table 1). Regression analysis of grain yield with components of yield highlighted differences in the relative importance of component contribution to yield between years (Table 2).

Table 1. The range in the relative effect on the yield of crops grown at elevated compared with normal [CO_2], with the warming above the seasonal mean which negates the benefit of high [CO_2] on grain yield in four years.

Year	Total biomass (%)	Grain yield (%)	Warming (°C)
1991/92	6-31	7-44	1.0
1992/93	34	72-168	1.8
1993/94	8-17	7-46	2.0
1994/95	17-33	31-58	1.2

Table 2. Percentage variation accounted for by regression analysis of grain yield (g m^{-2}) on total biomass or components of grain yield at harvest maturity in four years. (D.F. from 1991/92-1994/95 are 38, 42, 46, 46: *[1] Residual variance exceeds variance of Y variate)

	Total biomass	Ears	Grains		Grain mass	
Year	(g m^{-2})	(m^{-2})	(m^{-2})	(ear^{-1})	(mg)	(g ear^{-1})
1991/92	45.1	6.2	86.7	79.4	81.9	94.2
1992/93	66.6	1.4	80.5	62.4	8.6	87.3
1993/94	49.4	26.6	63.4	3.7	*[1]	4.9
1994/95	86.1	81.0	77.4	*[1]	89.5	85.4

Conclusions

Comparatively limited seasonal warming negates the grain yield increases at elevated [CO_2], within the temperature ranges investigated (or with limited extrapolation). Different responses of grain yield to [CO_2] and temperature are explained from seasonal differences in biomass partitioning and yield component adjustments: seasonal differences in other environmental factors, such as radiation levels, will also contribute to the yield responses. Accordingly, the impact of climate change on winter wheat production, especially grain yield, is likely to be highly influenced by the relative increases in these two factors.

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EVALUATION OF METHODS FOR DETERMINATION AVAILABLE PHOSPHORUS BY CAMBISOL FROM REGION TACHOV

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Introduction

The evaluation of methods for determination available and nutritive conditions of phosphate is dependent on the character of study soil. The study of cambisols is very problematic. The evaluate are select methods: Egner, Olsen, Mehlich II and $CaCl_2$. The evaluation is by forms of available phosphorus which select method priority release from soil and by relationship with P uptake.

Methods

Averages of results from yearly observation of long multifactorial trial performed in the period 1982-87 were used to characterize of methods and nutritive condition of eutric cambisol from the site Pernolec, the Tachov region.

Characteristic of soil: soil texture-medium (sandy-loam), climatic region-mildly warm and humid, production region-potato.

P uptake: The plants were analyzed after harvest.

Plants and doses of fertilizers (ha): 1982-winter wheat (130-70 kg N-K), 1983-spring barley (100-70-3500 kg N-K-Ca), 1984-potato (125-150 kg N-K, 40 t manure), 1985-spring barley (75-70 kg N-K), 1986,87-lucerne (40-100-3500 kg N-K-Ca). At doses of N-K fertilizers was P-fertililzation by doses O, 20, 40, 60 and 80 kg P.

Total forms of available phosphorus: Pk+Pv - available, Pk - mobile, Pv - water-soluble (Macháček, 1986).

Results

Results are presented in Table 1 and 2.

Table 1. The survey of regression (a,b,c,) and correlation (r) coefficients of pol. 2nd orders of dependence of indicators an P uptake on the P dose

	a	b	c 10^{-3}	r
Mehlich II	131	0.121	8.51	0.999
Egner	74	0.297	3.83	0.999
Olsen	67	0.129	3.34	0.994
$CaCl_2$	346	0.919	42.40	0.996
Pk+Pv	140	0.376	7.53	0.999
Pv	38	- 0.012	2.52	0.990
Pk	130	0.493	3.58	0.999
P uptake	19.3	0.002	0.14	0.989

Table 2. The survey of regression (a,b) and correlation (r) coefficients of pol. of the lst order dependence of P uptake on the results of the methods

	a	b	r
Egner	18.1	0.013	0.582
Olsen	17.3	0.026	0.683
Mehlich II	17.4	0.012	0.684
$CaCl_2$	18.2	2.324	0.615
Pk+Pv	17.8	0.009	0.615
Pv	17.2	0.050	0.704
Pk	18.0	0.011	0.590

Conclusions

Extraction power of the methods falls in the following sequence:
Pk+Pv, Mehlich II, Pk, Egner, Olsen and Pv. Extraction by $CaCl_2$ was not evaluated for different value (μg P $dm.^{-3}$), the other mg P kg^{-1} soil. At fertilization up to 40 kg P a larger part of P from fertilizer enters into compounds which are given genetically (Al-P, Fe-P) and are preferably determined by Mehlich´s II and Olsen´s methods. Larger part of P remains in Ca-P form with a dose over 40 kg P and has been preferably determined by the methods after Egner and $CaCl_2$. The methods after Mehlich II and Olsen are on identical insignificant level, as the extracting agents of both methods release evenly P from Al-P and Fe-P compounds from the soil complex, which is not in the high retrogradation degree at a pH value of soil and is still available to plants. Retrogradation degree is already high for Egner´s method, and therefore a release of P from soil is limited. The agronomic practices should be performed in accordance with Mehlich´s method II. The Egner´s method used till now is unsuitable for cambisol.

Reference

Macháček, V., 1986, Patent number A0247986

SOME CHEMICAL PROPERTIES OF SLUDGES AND EFFECT OF SEWAGE SLUDGE ADDITION IN NUTRIENTS AND TRACE METALS CONTENTS OF SOILS

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Introduction

Agricultural application of sludge is widely practised in developed countries, for both practical and economical reasons (Ottaviani et al., 1991). Sludge is valuable as a fertiliser and in improving agriculture soil properties (Tester, 1990). The effect on acidic soil when amended to sewage sludge in different doses was observed and compared to the use of an inorganic fertiliser and a control.

Methods

Incubation experiments were carried out on acidic soil during three months. Four different doses of sludge (T_1, T_2,T_3, T_4 of 5, 10, 20 and 40 t ha^{-1} respectively) have been used and were compared to the application of an inorganic fertiliser (F; 200; 120, 100 kg ha^{-1} of N, P and K respectively) and to a control (C). Soil were sampled three times (a month each). The methods of Guitian et al. (1976) were used for analysis of pH, organic matter and nitrogen contents. The available content of metallic elements were extracted by EDTA and the exchangeable bases was determined by extraction using ammonium acetate at pH 7. The analysis was realised by atomic absorption spectrophotometry. The available content of P was determined by extraction using the Olsen procedure (Olsen et al., 1954). The P was analysed in the extracts by the colourmetric method of Murphy et al. (1962). Results are the mean value of three replicates and were expressed on a dry matter bases.

Results

Results are presented in Tables 1, 2 and 3.

Table1. Variation of the pH, O.M., N and P contents along the time of incubation.

	C	F	T_1	T_2	T_3	T_4
pH_{t-1}	6.09	5.67	6.48	6.63	6.81	6.86
pH_{t-2}	5.62	5.80	5.71	6.60	6.95	7.08
pH_{t-3}	5.34	5.77	5.96	6.71	6.91	6.95
$O.M._{t-1}$ (%)	7.97	6.51	8.30	7.85	9.78	10.77
$O.M._{t-2}$ (%)	6.69	5.63	5.48	6.51	7.41	8.56
$O.M._{t-3}$ (%)	5.34	4.08	7.26	7.70	5.36	8.49
$P_{avail.t-1}$ (mg kg^{-1})	30.90	246.60	-	41.90	85.70	104.10
$P_{avail.t-2}$ (mg kg^{-1})	29.40	265.80	46.30	56.80	88.00	155.50
$P_{avail.t-3}$ (mg kg^{-1})	43.20	331.20	55.30	79.40	95.00	147.60
N_{t-1} (%)	0.32	0.51	0.39	0.43	0.53	0.67
N_{t-2}(%)	0.31	0.44	0.33	0.43	0.55	0.63
N_{t-3}(%)	0.37	0.44	0.34	0.36	0.40	0.51
$(N\text{-}NH_4^+)_{t-1}$ (mg kg^{-1})	549	1292	424	435	386	478
$(N\text{-}NH_4^+)_{t-2}$ (mg kg^{-1})	520	1444	353	287	283	377
$(N\text{-}NH_4^+)_{t-3}$ (mg kg^{-1})	367	1452	385	313	307	451
$(N\text{-}NO_3^-)_{t-1}$ (mg kg^{-1})	-	887	-	-	-	55
$(N\text{-}NO_3^-)_{t-2}$ (mg kg^{-1})	57	738	200	46	95	-
$(N\text{-}NO_3^-)_{t-3}$ (mg kg^{-1})	26	340	235	-	-	-
$(C/N)_{t-1}$	14.47	7.41	18.97	9.58	24.83	28.00
$(C/N)_{t-2}$	12.55	7.48	9.64	8.79	7.85	7.88
$(C/N)_{t-3}$	8.43	5.40	12.41	12.42	7.78	9.67

Table 2. Variation of exchangeable bases contents along the time of incubation (cmol kg^{-1}).

	C	F	T_1	T_2	T_3	T_4
Mg_{t-1}	0.18	0.17	0.27	0.30	0.39	0.56
Mg_{t-2}	0.16	0.18	0.24	0.32	0.30	0.49
Mg_{t-3}	0.17	0.21	0.33	0.31	0.23	0.47
Na_{t-1}	0.49	0.51	0.65	0.67	0.53	0.71
Na_{t-2}	0.54	0.55	0.54	0.49	0.60	0.60
Na_{t-3}	0.57	0.73	0.59	0.58	0.46	0.57
Ca_{t-1}	0.20	0.21	1.91	4.48	8.61	14.66
Ca_{t-2}	0.18	0.18	2.18	4.83	12.02	14.64
Ca_{t-3}	0.19	0.22	3.43	4.70	9.39	17.92
K_{t-1}	1.12	5.28	1.18	1.18	1.17	1.32
K_{t-2}	1.07	5.62	1.04	1.07	1.15	1.14
K_{t-3}	1.03	6.03	1.05	1.16	1.06	1.16

Table 3. Variation of assimilable content of Cu, Cd and Zn along the time of incubation (mg kg^{-1}).

	C	F	T_1	T_2	T_3	T_4
Cu_{t-1}	0.41	0.20	0.62	0.81	1.83	3.28
Cu_{t-2}	0.20	0.20	0.71	0.81	1.23	2.67
Cu_{t-3}	0.41	0.41	0.41	0.81	1.00	2.87
Cd_{t-1}	0.06	0.08	0.06	0.08	0.20	0.06
Cd_{t-2}	0.06	0.06	0.06	0.06	0.08	0.08
Cd_{t-3}	0.06	0.04	0.06	0.06	0.04	0.06
Zn_{t-1}	0.41	1.01	0.80	1.22	1.22	3.49
Zn_{t-2}	1.02	1.02	2.44	1.83	2.67	4.93
Zn_{t-3}	1.42	1.41	2.02	2.23	2.23	3.67

Conclusions

1.The sludge has no significative differences in the composition dues to climatological differences or of density of population.

2. The composition of sludge has important contents of P, K and organic matter. The contents of inorganic N lower than the organic one.

3. The heavy metal contents do not exceed the established limits for their addition to soil.

4. Significant differences in soil pH and organic matter, N, P, Cu and Zn contents between soils amended with the highest doses of sludge and controls remained along the experience.

5. It has been found a very important increase in the content of exchangeable Ca in the soil due to the high concentration of this element in the sewage sludge, that is the consequence of the treatments that receive the waters in wastewater treatment plant. This increase is parallel to the increase of the pH.

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