Is Eastern Europe a Useful Source of New Landscape Plants for the Midwest?

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INTRODUCTION

Climatic extremes and unfavorable soils limit landscape plant diversity in the midwestern U.S. Since 1983, I have coordinated the NC-7 Regional Ornamental Trials (Widrlechner, 1990) for evaluating new landscape plants in the region and for increasing the future diversity of well-adapted plants found in commerce. I acquire, propagate, and distribute promising new plants for long-term testing at 38 sites representing the region's climates and soils.

Plants for testing can come from breeding programs or public gardens, but often originate from wild collections. Selecting promising plants for testing from the native woody flora of the temperate world is not simple, especially when many species are poorly adapted to our region. Fortunately, past experiences from the NC-7 Trials may increase the likelihood of future success. For example, populations of trees and shrubs collected in the former nation of Yugoslavia were distributed for testing in the mid-1970s. Analyses of the performance of 27 of these populations in relation to climatic conditions at test sites (Widrlechner et al., 1992) may help answer the question "Is eastern Europe a useful source of new landscape plants for the midwest?"

PERFORMANCE OF INTRODUCTIONS FROM YUGOSLAVIA

Of 27 populations evaluated in seven midwestern states, about one third survived and generally performed well throughout the region; another third failed at the colder or drier test sites; and the remaining third failed at all sites. Statistically significant multiple-regression models, based on both low winter temperatures and moisture conditions at test sites, explained 84% of variation for first-year survival and 56% of variation for overall survival across all sites (Widrlechner et al., 1992). Three measures of low temperature (long-term January means, average minima, and the proportion of years with minima $\leq 32^{\circ}C$) were examined with similar results. Long-term, January mean temperatures were readily available and models incorporating those data were not significantly different from models based on extremes. Moisture conditions were estimated by Mather and Yoshioka's (1968) moisture index, based on the ratio of annual precipitation to potential evapotranspiration.

Evaluation results suggested that climates at collection sites did not correspond well to conditions at test sites and that future explorations in eastern Europe could be more productive if directed to areas with more suitable climates. Four specific criteria for directing future exploration were developed to identify such sites. My report applies these criteria to eastern European conditions and identifies sites with suitable climates.

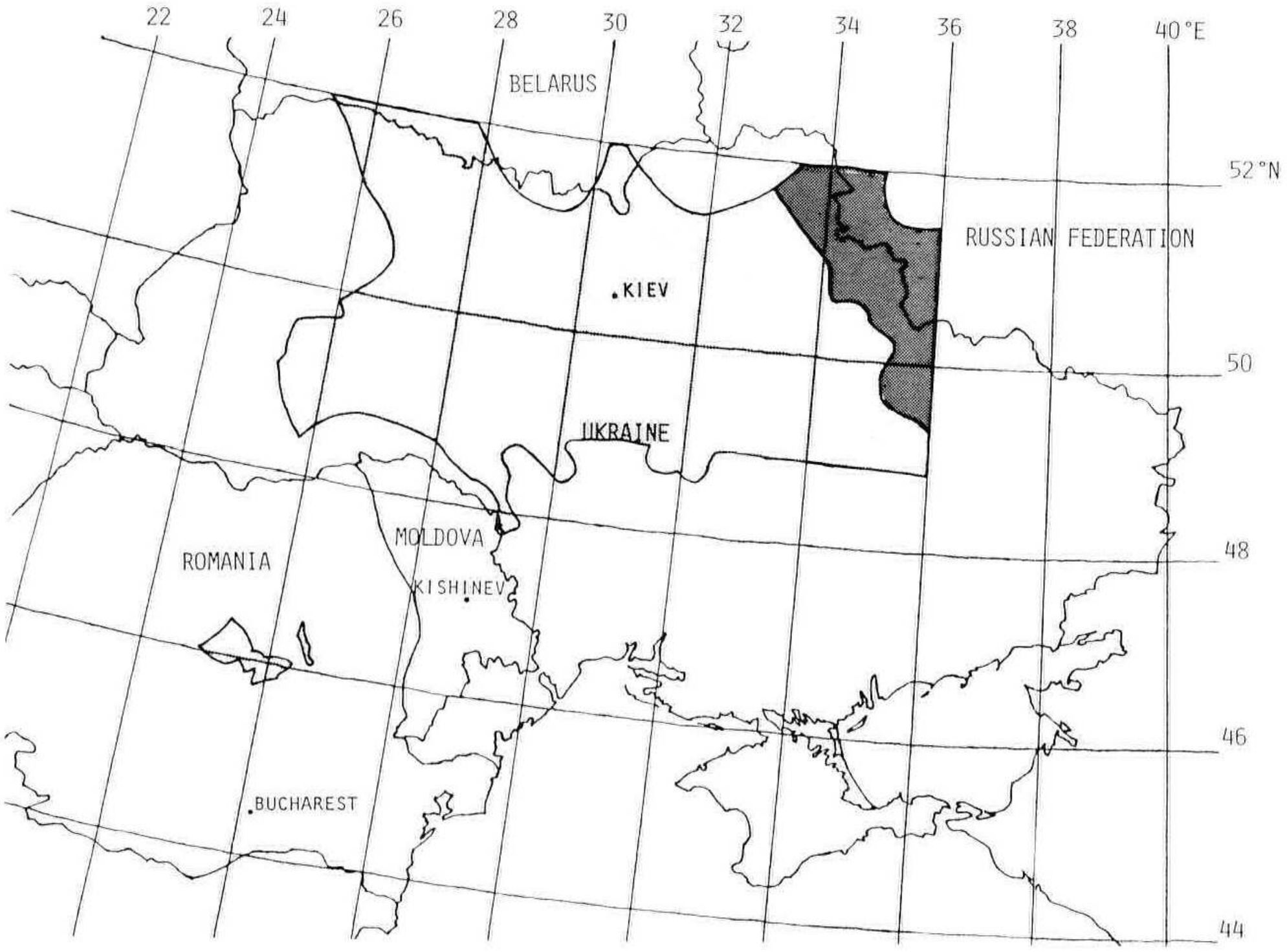

Figure 1. January mean temperatures within climatically-suitable areas in eastern Europe. Light shading: -5 to -7.5°C; medium shading: -7.5 to -10°C.

PROMISING CLIMATIC REGIONS IN EASTERN EUROPE

Eastern European sites with woody plants better adapted to the midwest than those from Yugoslavia should have: (1) January mean temperatures (T_{Jan}) ≤ 5°C; (2) moderate, annual moisture deficits; (3) July mean temperatures (T_{Jul}) $\leq$ 18°C; (4) elevations $\leq$ 1,000 meters (Widrlechner et al., 1992). These four criteria were measured in a region bounded by 18 to 36°E longitude and 44 to 52°N latitude. The western and southern borders were set from temperature data. All sites south or west of the borders, with $T_{Jan} \leq 5$°C, were high elevation sites or had excessively cool summers. The northern border was set at 52°N to account for differences in photoperiod between northern regions and those of middle latitudes. Many woody plants from high latitudes are poorly adapted at lower latitudes having shorter photoperiods during the growing season (Pauley and Perry, 1954; Maynard and Hall, 1980). The eastern border roughly corresponds to Komarov's southwest Russian floristic region as presented by Tutin et al. (1964). As one travels east from this region, the composition of the local flora gradually shifts from a European flora to one with affinities to the Caucasus and central Asia. The four criteria listed above were based on the performance of Yugoslavian plants and may not apply to species from the Caucasus or central Asia that evolved under different climatic or edaphic conditions.

Mean temperature and precipitation data for eastern Europe were obtained from the *Climatic Atlas of Europe* (1970). Since this source did not have an 18°C isotherm

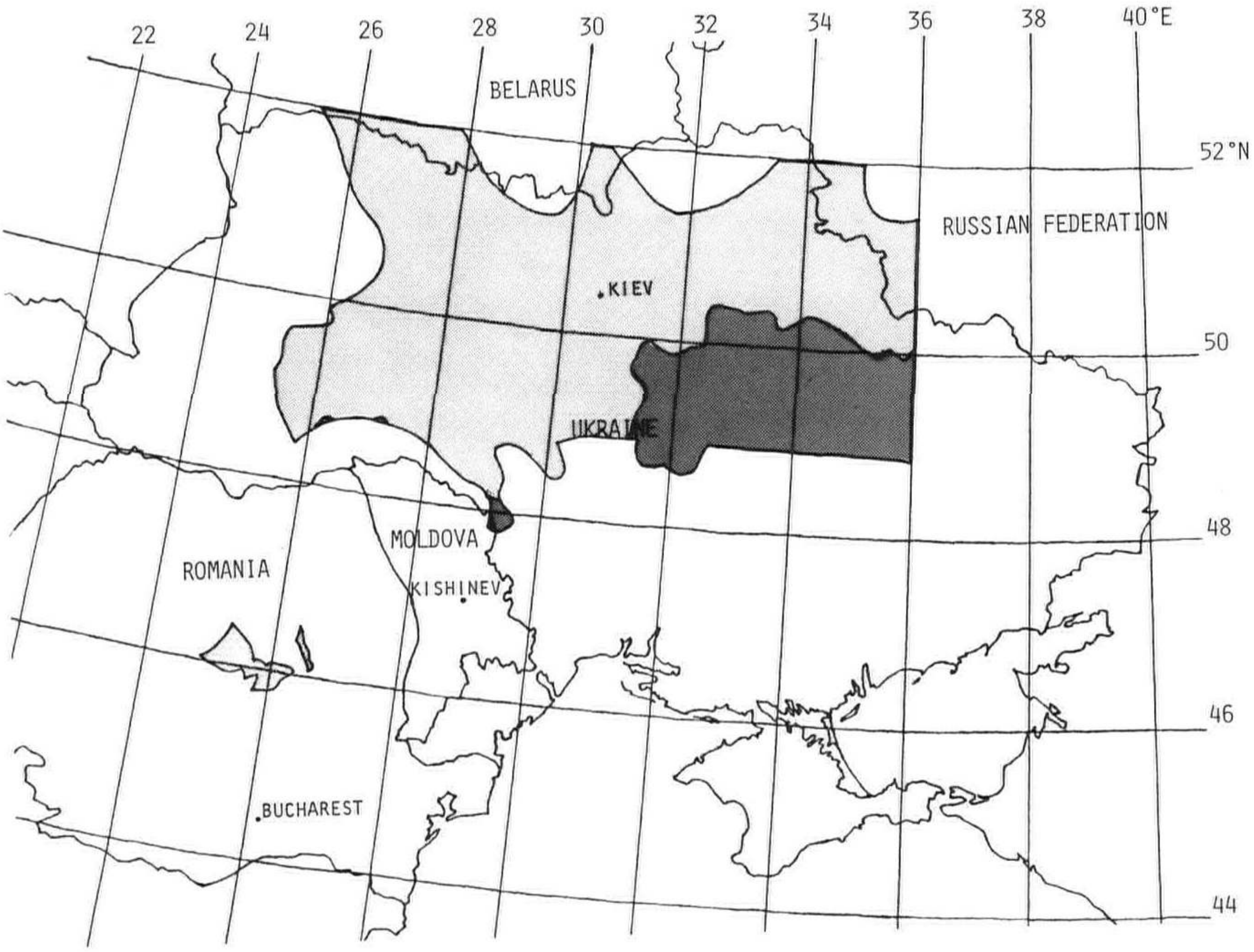

Figure 2. July mean temperatures within climatically-suitable areas in eastern Europe. Light shading: 17.5 to 20°C; medium shading: 20 to 22.5°C.

for July, a 17.5°C isotherm was substituted. Moisture indices were computed by comparing precipitation data to Thran and Broekhuizen's (1965) map of potential evapotranspiration. Indices of 0 to -30 were used to meet the recommendation of a moderate deficit: -30 was the lowest moisture index found at any test site in the earlier study. Elevation data were taken from the *Times Atlas of the World* (1975).

From this analysis, much of Ukraine, and adjacent portions of Belarus, the Russian Federation, and Moldova met all four conditions, as did two small areas in the foothills of the southern Carpathian Mountains in central Romania. Figures 1 to 3 illustrate T_{Jan}, T_{Jul}, and moisture indices for these areas. These areas have T_{Jan} from -5 to -8°C, comparable to winter conditions at Rockford, Illinois or Fort Wayne, Indiana, have T_{Jul} from 17.5 to 21°C, which are somewhat cooler than either Rockford (22.8°C) or Fort Wayne (23°C), and have moisture indices similar to much of the northern Great Plains. There are no perfect climatic analogs in the midwest possessing these eastern European conditions. Temperature analogs can be found at Milwaukee, Wisconsin or Flint, Michigan, but such locations are more moist than the eastern European counterparts.

OTHER CONSIDERATIONS

The criteria tested here would be worthless if areas meeting those criteria were grasslands lacking useful woody plants. Apparently, these areas do include mixed and deciduous woodlands, grasslands, and transitional communities (Pergamon

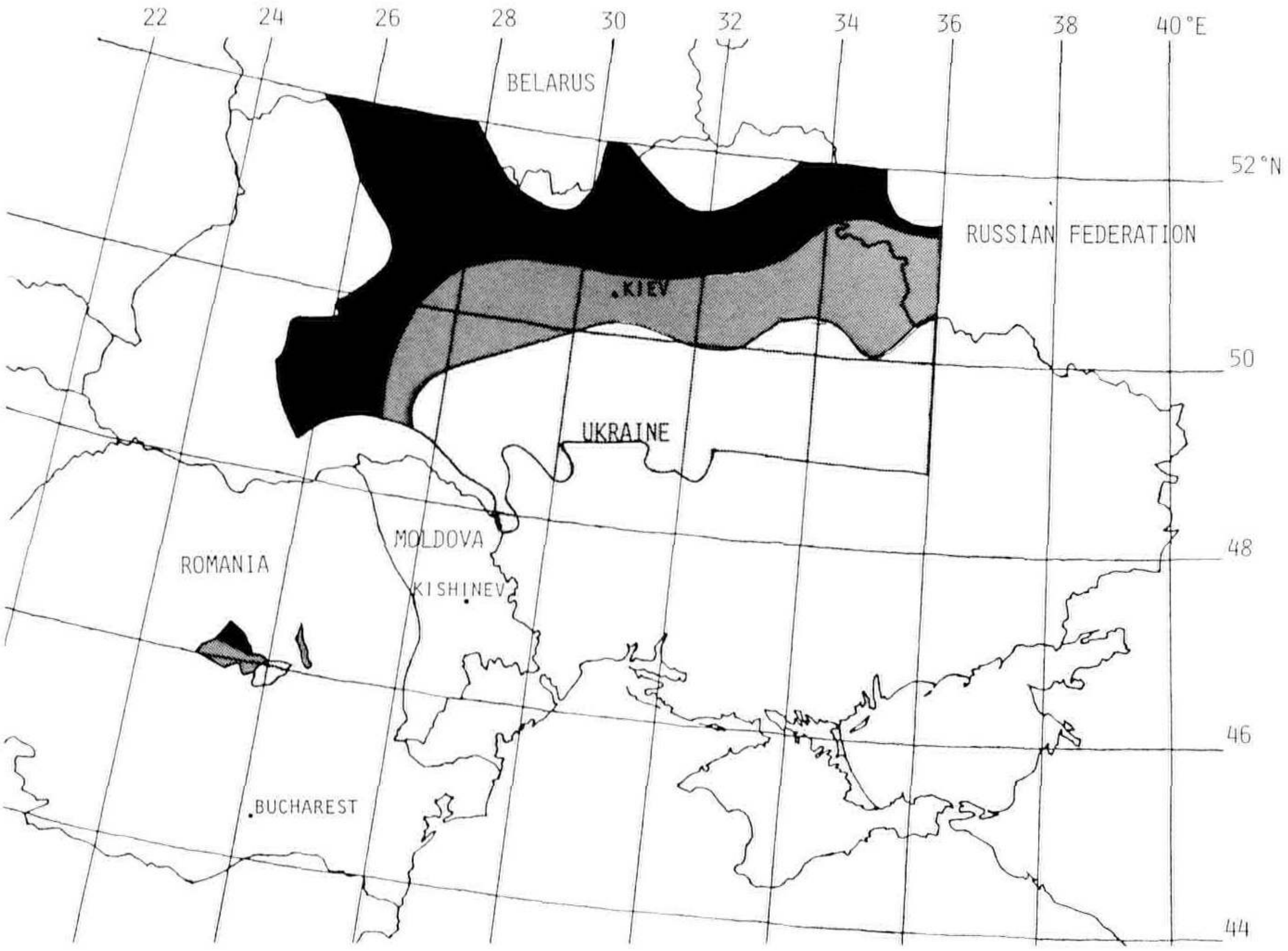

Figure 3. Moisture index, measured as 100|(annual mean precipitation / potential evapotranspiration) - 1|(Mather and Yoshioka, 1968), within climatically-suitable areas in eastern Europe. Dark shading: 0 to -10; medium shading: -10 to -20; light shading: -20 to -30.

World Atlas, 1968), similar to natural plant communities in Minnesota and Wisconsin, where coniferous forests, deciduous forests, and prairies are in close proximity (Küchler, 1964).

The final steps to locate promising collection sites rely on analyses of species composition and soil types. Which species found in the climatically-suitable region are good candidates for introduction? European species, such as *Acer campestre* and *Ligustrum vulgare*, are widely grown in the United States but are poorly adapted to much of the midwest. Collections from the northeastern part of their native ranges may be better adapted to our region. Of course, there is also need for caution. If climatic analogs are matched too well, introduced plants could be so well adapted that they might invade natural plant communities. Soils should also be examined. Are the soils at these sites poorly-drained, alkaline, or calcareous? Such sites would be of particular interest both in dealing with the challenges of urban substrates (compaction and calcareous inclusions) and of native, prairie soils. Once these questions are addressed, we may then discover how useful eastern Europe can be as a source of landscape plants for the midwest.

LITERATURE CITED

Climatic Atlas of Europe. 1970. Vol. 1. WMO, Geneva.

Küchler, A.W. 1964. Potential natural vegetation of the conterminous United States. Spec. Publ. 36. Amer. Geographical Soc., New York.

Mather, J.R. and **G.A. Yoshioka**. 1968. The role of climate in the distribution of vegetation. Ann. Assoc. Amer. Geogr. 58:29-41.

Maynard, C.A. and **R.B. Hall**. 1980. Early results of a range-wide provenance trial of *Alnus glutinosa* (L.) Gaertn. Proc. 27th NE For. Tree Improv. Conf., pp. 184-201.

Pauley, S.S. and **T.O. Perry**. 1954. Ecotypic variation of the photoperiodic response in *Populus*. J. Arnold Arb. 35:167-188.

Pergamon World Atlas. 1968. Pergamon Press, Oxford.

Thran, P. and **S. Broekhuizen**. 1965. Agro-climatic atlas of Europe. PUDOC, Wageningen.

Times Atlas of the World. 1975. Comprehensive ed. New York Times, New York.

Tutin, T.G., V.H. Heywood, N.A. Burges, D.H. Valentine, S.M. Walters and **D.A. Webb**. 1964. Flora Europaea. Vol. 1. Cambridge Univ. Press, Cambridge.

Widrlechner, M.P. 1990. NC-7 regional ornamental trials: evaluation of new woody plants. METRIA Proc. 7:41-47.

Widrlechner, M.P., E.R. Hasselkus, D.E. Herman, J.K. Iles, J.C. Pair, E.T. Paparozzi, R.E. Schutzki and **D.K. Wildung**. 1992. Performance of landscape plants from Yugoslavia in the North Central United States. J. Environ. Hort. 10:192-198.