

# What is **phenology**?

The science of the relations between climate and periodic biological phenomena (i.e leaf emergence, flowering, leaf senescence/drop, animal migration, hibernation etc.)

# Fall 2016 Phenology Presentation

Dr. John O'Keefe

Harvard Forest Schoolyard Ecology

# What are the main factors affecting the timing of woody species leaf phenology?

- **Fall leaf drop**
  - Temperature and frosts
  - Day length
  - Drought
  - Wind
- **Spring leafout**
  - Cold treatment
  - Cumulative heat sum (growing degree days)
  - Day length

**As leaves senesce in the fall chlorophyll breaks down and the components are stored for use in the spring. This reveals yellow pigments, carotenoids, which have also been present during the growing season, but masked by chlorophyll.**

**Many, but not all, trees in our area also have the ability to produce red pigments, called anthocyanins, by using energy from sunlight. These red pigments produce the beautiful orange, red and purple colors that make our forests so beautiful each fall.**



NAME: Jck DATE: 9-2-04 AM MID 60S CLR

COM NAME	TREE ID	TAG	LF COLOR	LF FALL	FOPEN	FPAST	COMMENTS
SHADBUSH	AMSP-01	PP003	-?	-			a couple of orange/yellow lvs
WHITE ASH	FRAM-01	PP004	~15%?	<1%?			yellow
BLK. CHERRY	PRSE-01	PP005	<5%?	~1%			yellow
RED MAPLE	ACRU-01	PP008	~1%?	-?			yellowing
SHADBUSH	AMSP-02	PP011	<1%	-			orange/yellow
SUG. MAPLE	ACSA-01	PP012	-	-			
BLK. BIRCH	BELE-01	PP013	~1%	-?			yellow
YEL. BIRCH	BEAL-01	PP014	~1%	-?			a few lvs on ground yellow
RED OAK	QURU-01	PP016	-?	-			poss slight yellowing
WHITE OAK	QUAL-04	PP019A	-	-			
BEECH	FAGR-01	PP020	-	-			Slight yellowing
STR. MAPLE	ACPE-01	PP022	~1%	-?			a few lvs yellow
BLACK OAK	QUVE-01	PP024	-	-			
PAPER BIRCH	BEPA-01	PP031	<1%	-?			a few yellowing lvs
RED MAPLE	ACRU-02	PP033	~5%	~1%?			yellow/red
STR. MAPLE	ACRE-02	PP035	~1%	-?			yellow
BLACK GUM	NYSY-04	PP037A	~1%?	-			yellow/orange
BEECH	FAGR-05	PP039A	-	-			
STR. MAPLE	ACPE-03	PP040	-?	-			
YEL. BIRCH	BEAL-02	PP042	-	-			
BLK. BIRCH	BELE-02	PP043	-	-			
BEECH	FAGR-06	PP046A	-	-			
SHADBUSH	AMSP-03	PP056	~1%	-?			yellow (a few lvs)
BLACK GUM	NYSY-02	PP057	<1%	-			several webworm nests reference
YEL. BIRCH	BEAL-03	PP059	-?	-			
BLACK GUM	NYSY-03	PP059A	~3%	-?			orange/red
RED OAK	QURU-02	PP061	-	-			
RED MAPLE	ACRU-03	PP063	<1%	-?			a few yellowing lvs
STR. MAPLE	ACPE-04	PP067	-?	-			Some paling
BLACK OAK	QUVE-02	PP069	-	-			
RED MAPLE	ACRU-04	PP074	~1%	-?			yellow
WHITE OAK	QUAL-02	PP075	<1%	-?			yellow/red
BLK. BIRCH	BELE-03	PP079	-	-			
BLACK OAK	QUVE-03	PP081	~3%	-?			yellow/brown
BLACK OAK	QUVE-04	PP083	-	-			
RED OAK	QURU-03	PP084	-	-			
BLK. CHERRY	PRSE-02	PP086	~10%?	~1%			Yellow/brown
PAPER BIRCH	BEPA-02	PP087	-	-			
PAPER BIRCH	BEPA-03	PP088	-	-			
PAPER BIRCH	BEPA-04	PP089	~3%?	~2%?			yellow/brown
WHITE ASH	FRAM-02	PP091	-?	-			
BEECH	FAGR-04	PP092	-	-			
WHITE OAK	QUAL-03	PP093	-	-			
SUG. MAPLE	ACSA-02	PP095	-	-			
WHITE ASH	FRAM-03	PP096	-	-			
SUG. MAPLE	ACSA-03	PP103	~1%	<1%			orange/yellow
BLK. CHERRY	PRSE-04	PP104A	~1%	-?			yellow - several webworm nests
RED OAK	QURU-04	PP105	-?	-			a few brown/yellow lvs
RED MAPLE	ACRU-05	PP106	~2%	-?			tinged red
WHITE ASH	FRAM-04	PP108	-	-			

STREAM BY #10 not flowing a few small puddles.

STREAM BY #42 not flowing - a few puddles mud damp.

STREAM BY #84 dry muddy

STREAM BY #94 not flowing/no puddles

HEMLOCK HOLLOW small pool of water (2-3m across) <5% fall.

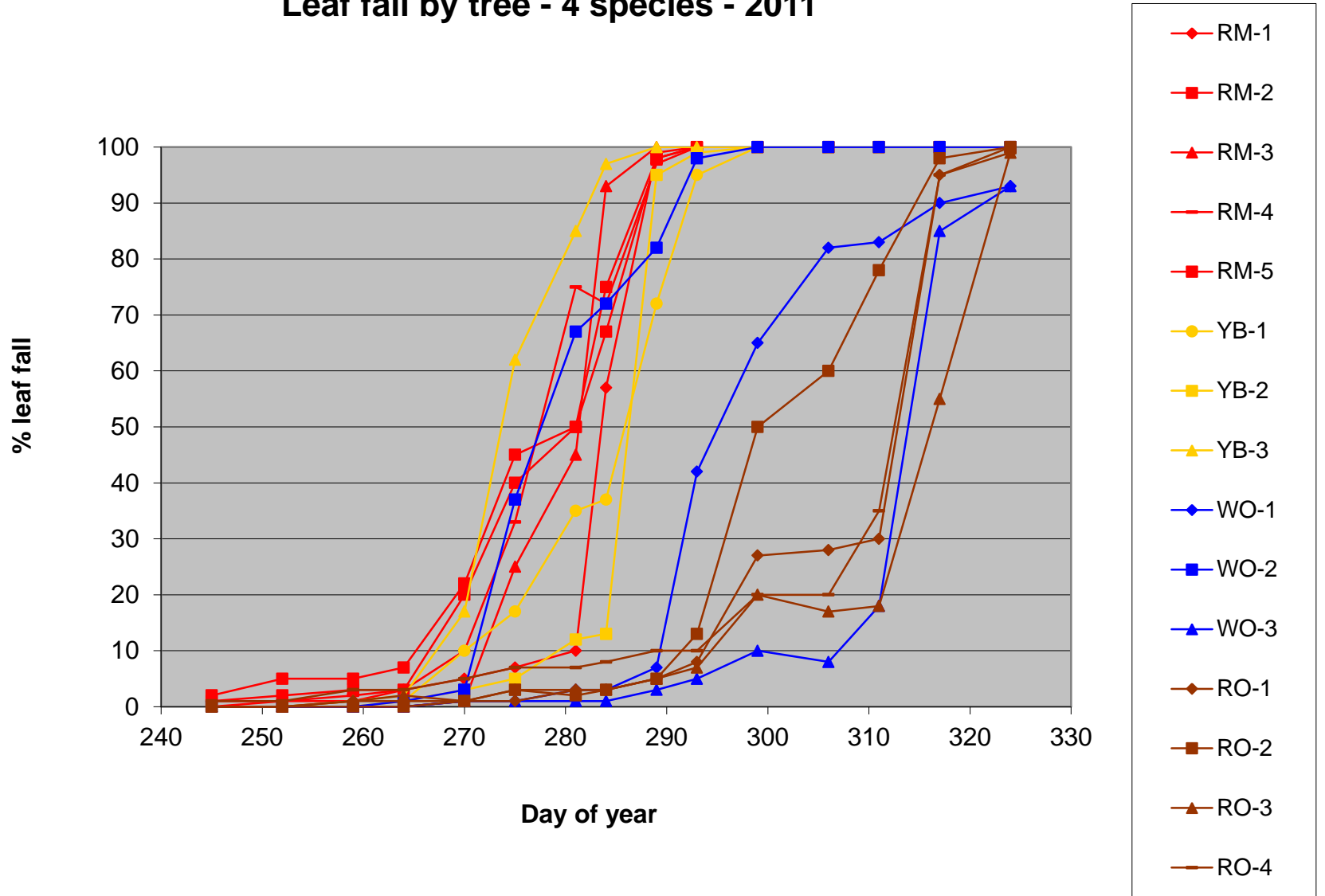
Closed like N - piling none fallen mid west.  
S - " " " "

Anonymous - brown - 10%  
" slope N - 10%  
" trees S -



DATE	TREE ID	TAG	LF COLOR	LF FALL	FOPEN	FPAST	COMMENTS	CIRCUIT
9/2/2004	AMSP-01	PP003	0	0				1
9/7/2004	AMSP-01	PP003	1	0				1
9/16/2004	AMSP-01	PP003	3	1				1
9/23/2004	AMSP-01	PP003	5	1				1
9/30/2004	AMSP-01	PP003	23	2				1
10/7/2004	AMSP-01	PP003	45	5				1
10/12/2004	AMSP-01	PP003	95	35				1
10/16/2004	AMSP-01	PP003	99	92				1
10/22/2004	AMSP-01	PP003	100	100				1
10/28/2004	AMSP-01	PP003	100	100				1
11/4/2004	AMSP-01	PP003	100	100				1
11/16/2004	AMSP-01	PP003	100	100				1
9/2/2004	FRAM-01	PP004	15	0				2
9/7/2004	FRAM-01	PP004	18	1				2
9/16/2004	FRAM-01	PP004	50	5				2
9/23/2004	FRAM-01	PP004	65	8				2
9/30/2004	FRAM-01	PP004	95	70				2
10/7/2004	FRAM-01	PP004	100	98				2
10/12/2004	FRAM-01	PP004	100	100				2
10/16/2004	FRAM-01	PP004	100	100				2
10/22/2004	FRAM-01	PP004	100	100				2
10/28/2004	FRAM-01	PP004	100	100				2
11/4/2004	FRAM-01	PP004	100	100				2
11/16/2004	FRAM-01	PP004	100	100				2
9/2/2004	PRSE-01	PP005	3	1				3
9/7/2004	PRSE-01	PP005	3	1				3
9/16/2004	PRSE-01	PP005	18	5				3
9/23/2004	PRSE-01	PP005	18	15				3
9/30/2004	PRSE-01	PP005	15	17				3
10/7/2004	PRSE-01	PP005	17	27				3
10/12/2004	PRSE-01	PP005	40	50				3
10/16/2004	PRSE-01	PP005	65	55				3
10/22/2004	PRSE-01	PP005	80	73				3
10/28/2004	PRSE-01	PP005	95	85				3
11/4/2004	PRSE-01	PP005	100	100				3
11/16/2004	PRSE-01	PP005	100	100				3
9/2/2004	ACRU-01	PP008	1	0				4
9/7/2004	ACRU-01	PP008	1	0				4
9/16/2004	ACRU-01	PP008	7	1				4
9/23/2004	ACRU-01	PP008	10	2				4
9/30/2004	ACRU-01	PP008	22	8				4
10/7/2004	ACRU-01	PP008	80	15				4
10/12/2004	ACRU-01	PP008	100	90				4
10/16/2004	ACRU-01	PP008	100	100				4
10/22/2004	ACRU-01	PP008	100	100				4
10/28/2004	ACRU-01	PP008	100	100				4
11/4/2004	ACRU-01	PP008	100	100				4
11/16/2004	ACRU-01	PP008	100	100				4
9/2/2004	AMSP-02	PP011	0	0				5
9/7/2004	AMSP-02	PP011	0	0				5
9/16/2004	AMSP-02	PP011	3	0				5
9/23/2004	AMSP-02	PP011	3	0				5
9/30/2004	AMSP-02	PP011	7	1				5
10/7/2004	AMSP-02	PP011	20	2				5
10/12/2004	AMSP-02	PP011	90	10				5
10/16/2004	AMSP-02	PP011	99	30				5
10/22/2004	AMSP-02	PP011	100	82				5

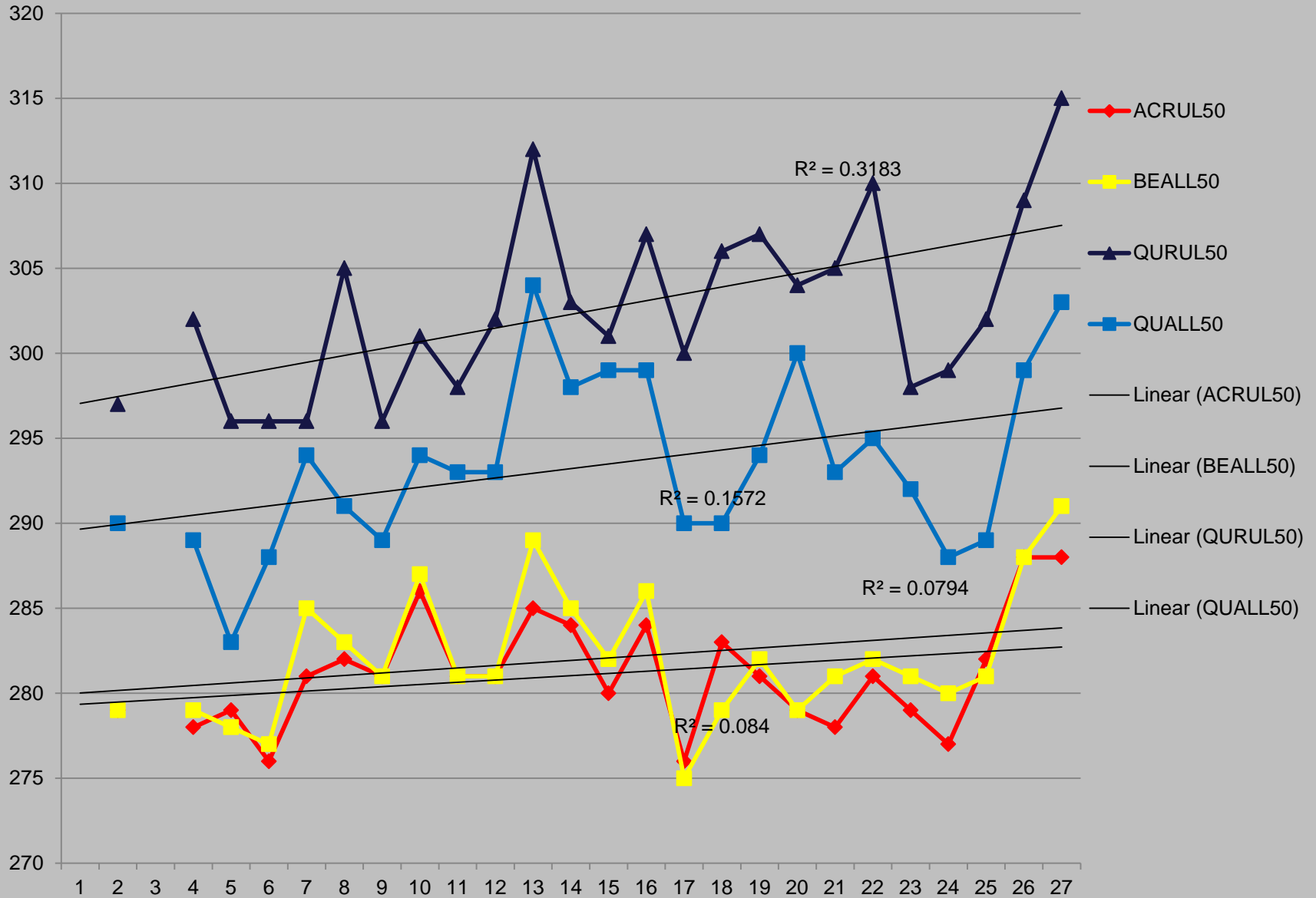
# Leaf fall by tree - 4 species - 2011



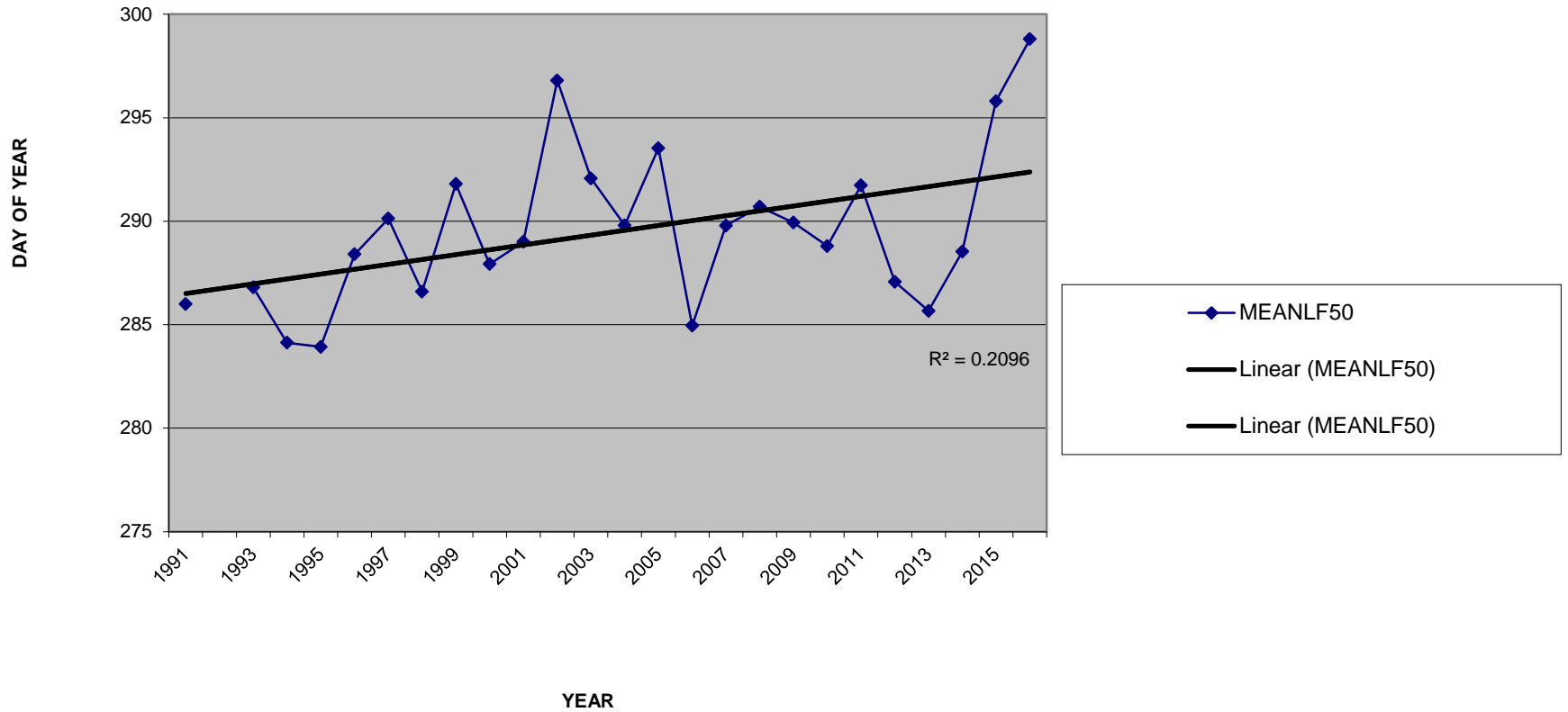




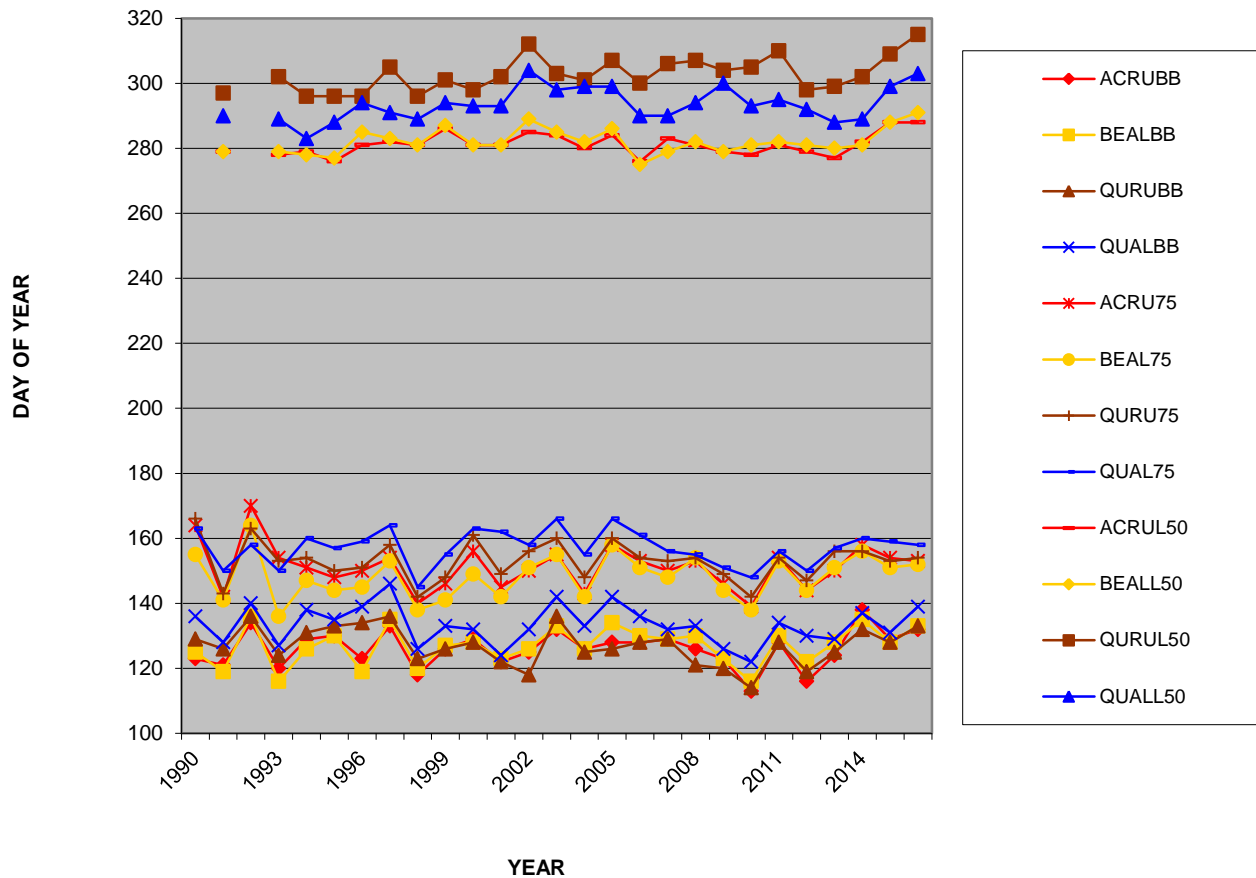
# 50% Leaf Fall by Species 1991-2016



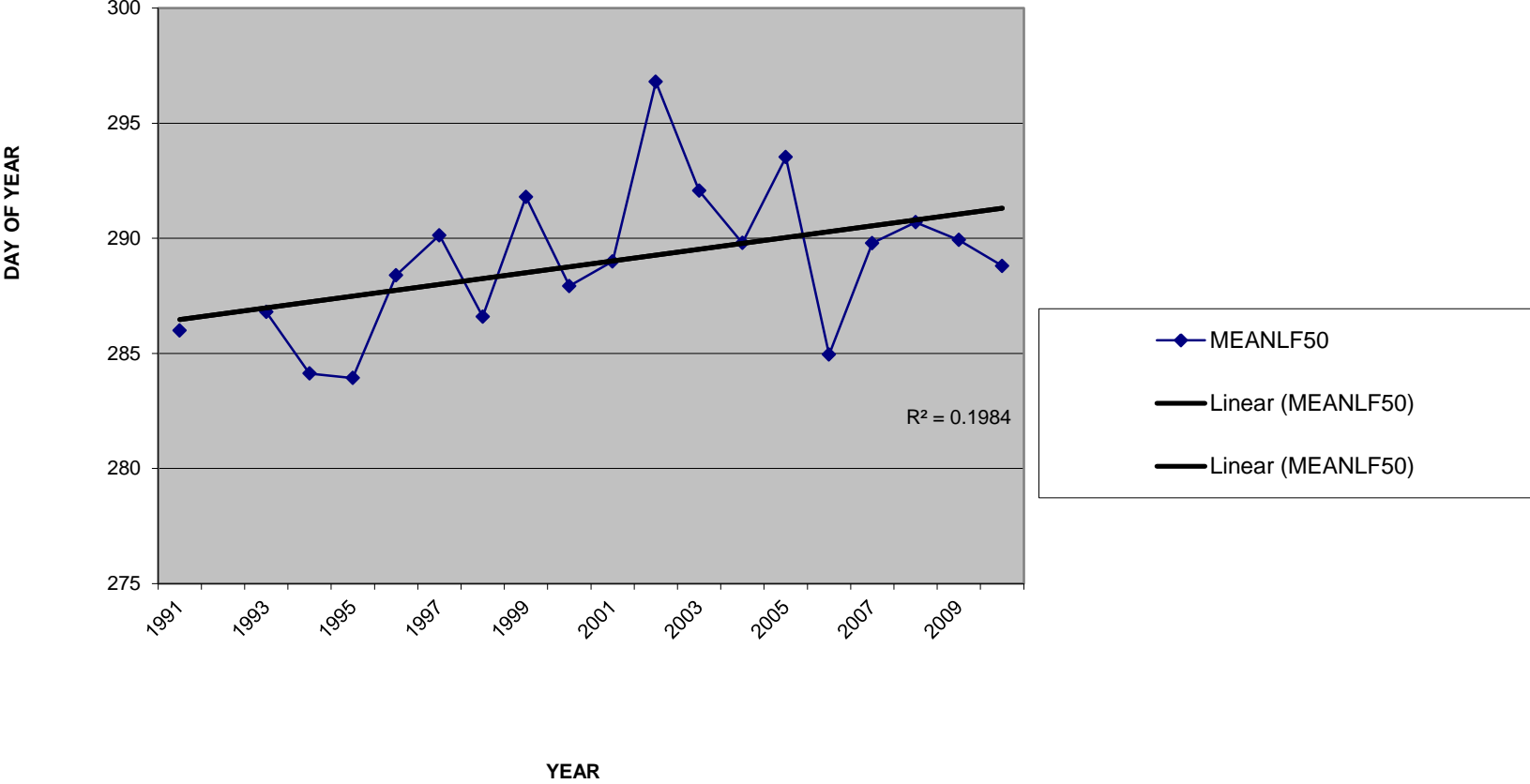
### MEAN LF50 (4 SPP, N=15)



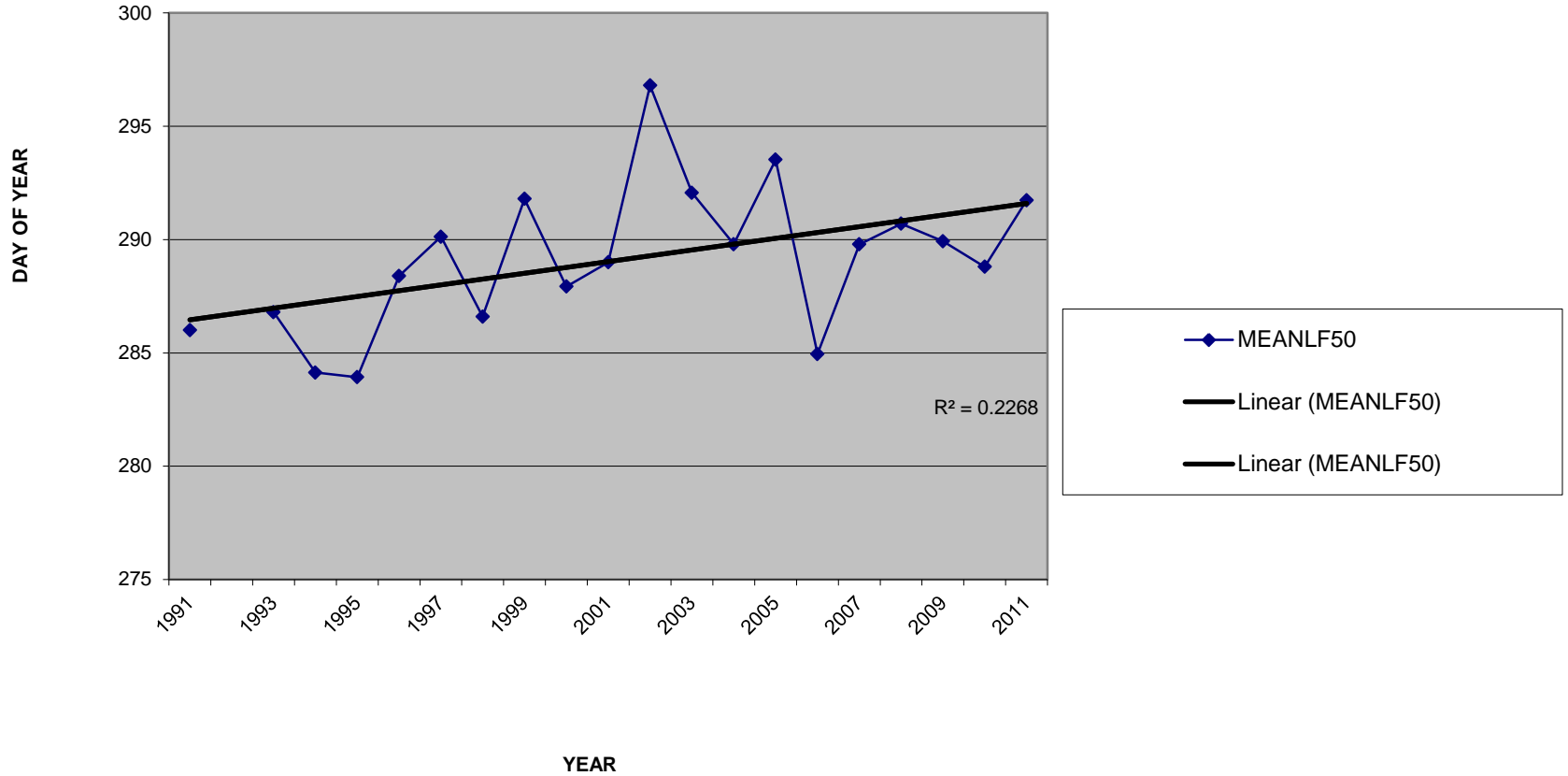
Mean 50% bud break(BB), 75% leaf development(75) and 50% leaf fall(L50) for 4 species (Acer rubrum-ACRU n=5, Betula alleghaniensis-BEAL n=3, Quercus rubra-QURU n=4 and Q. alba-QUAL n=3)



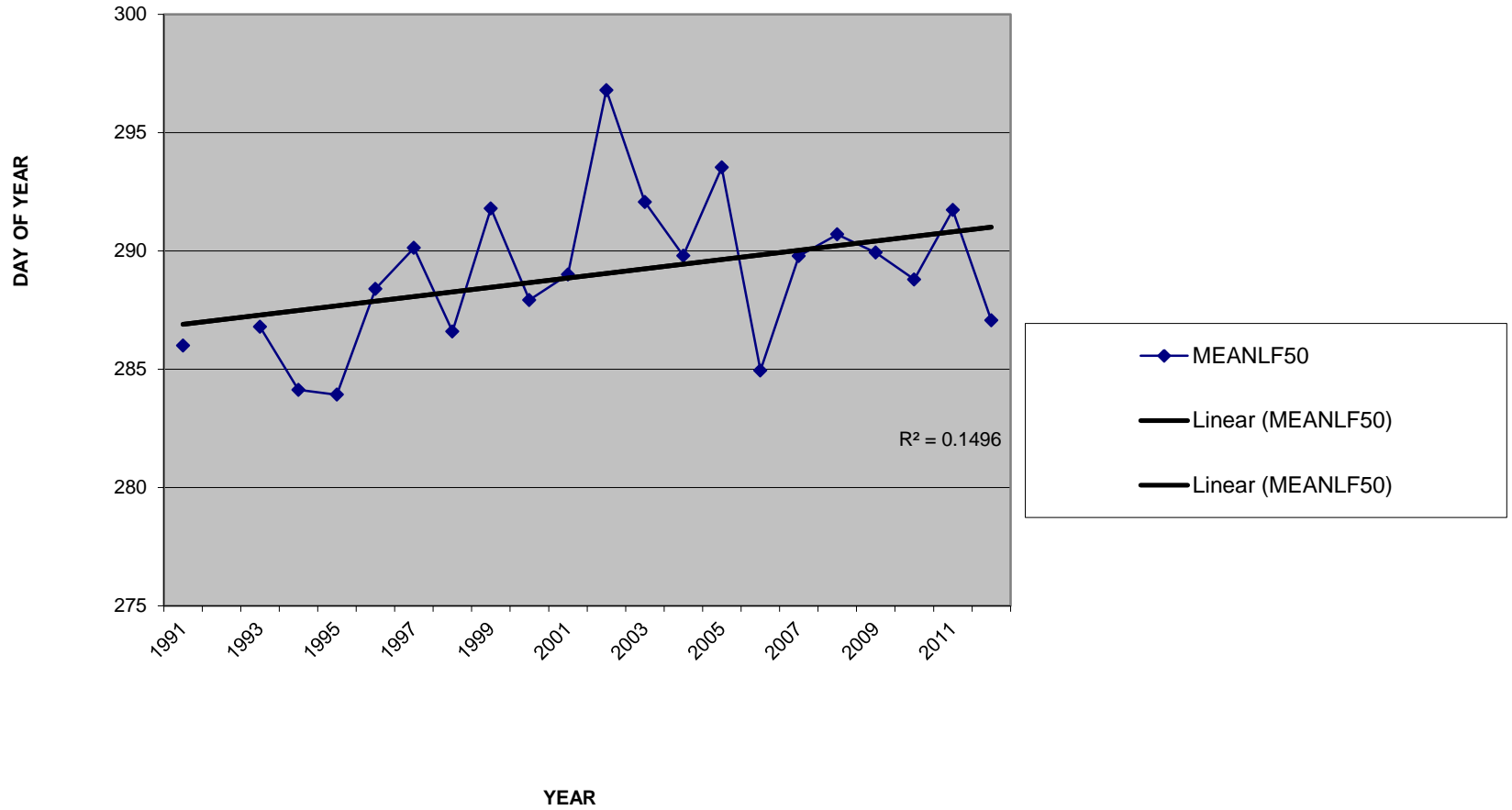
### MEAN LF50 (4 SPP, N=15)



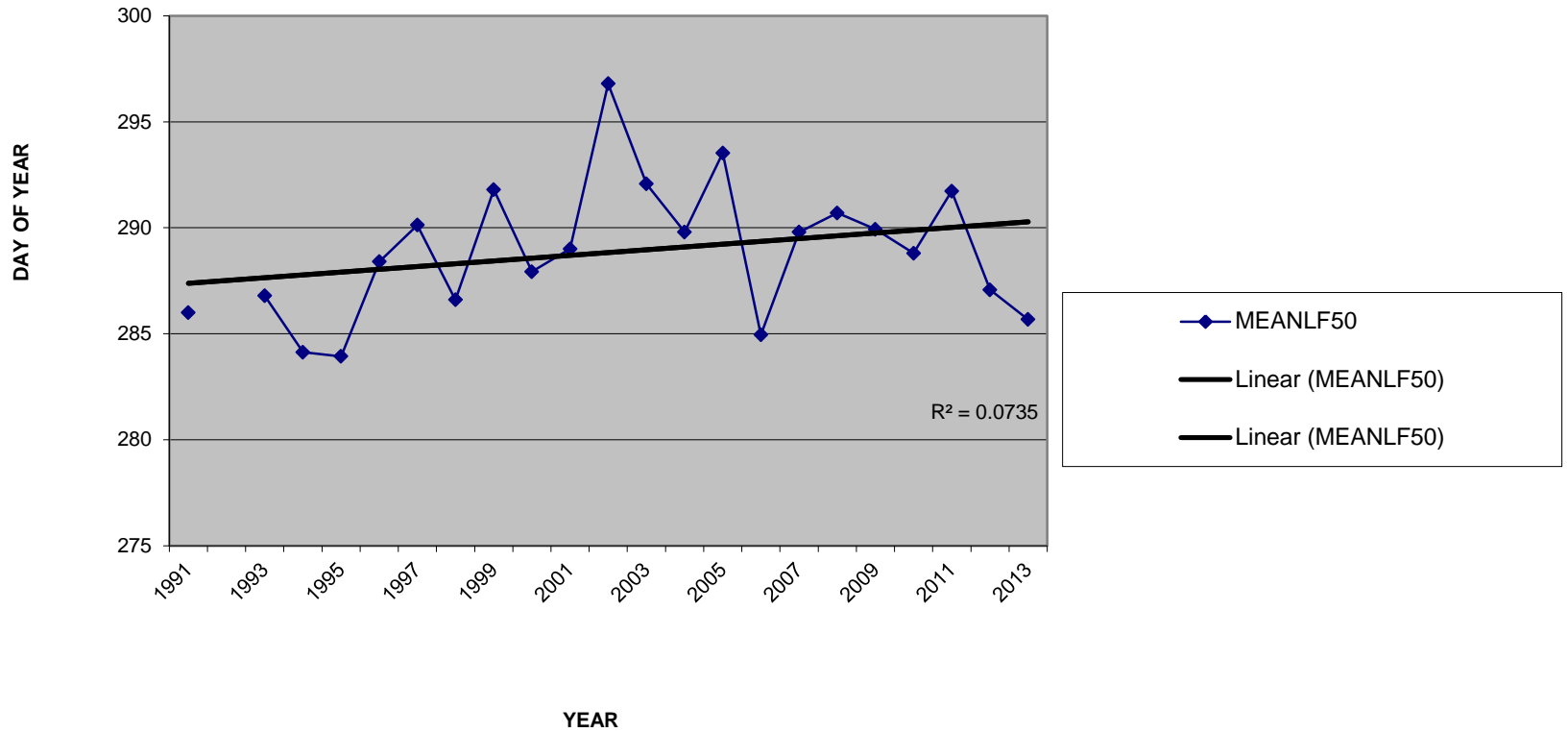
# MEAN LF50 (4 SPP, N=15)



# MEAN LF50 (4 SPP, N=15)

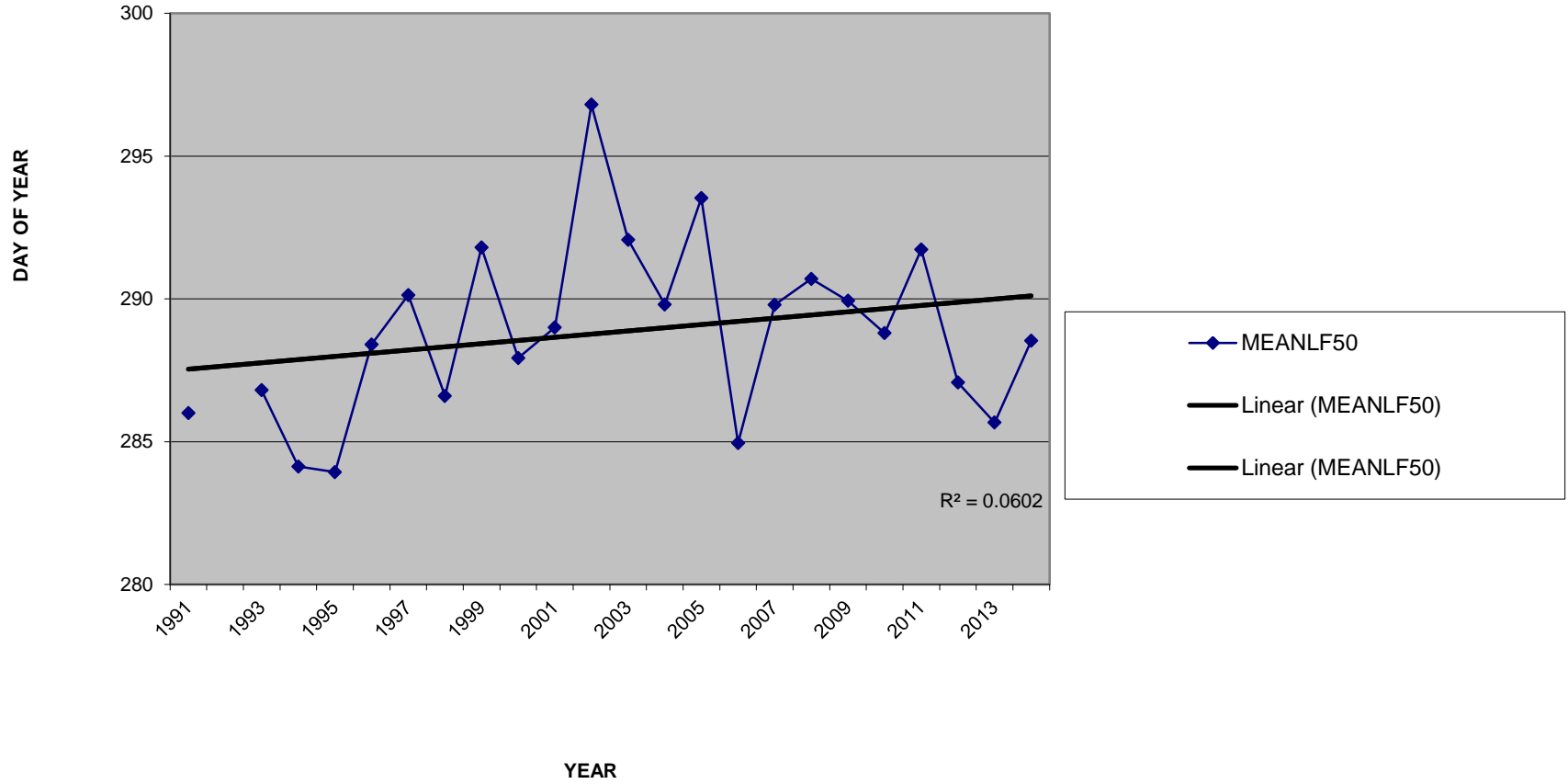


### MEAN LF50 (4 SPP, N=15)

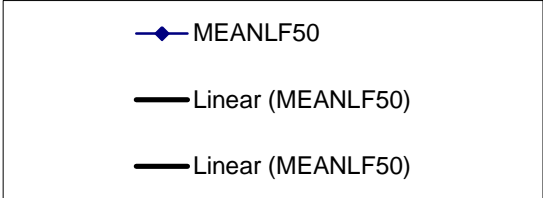
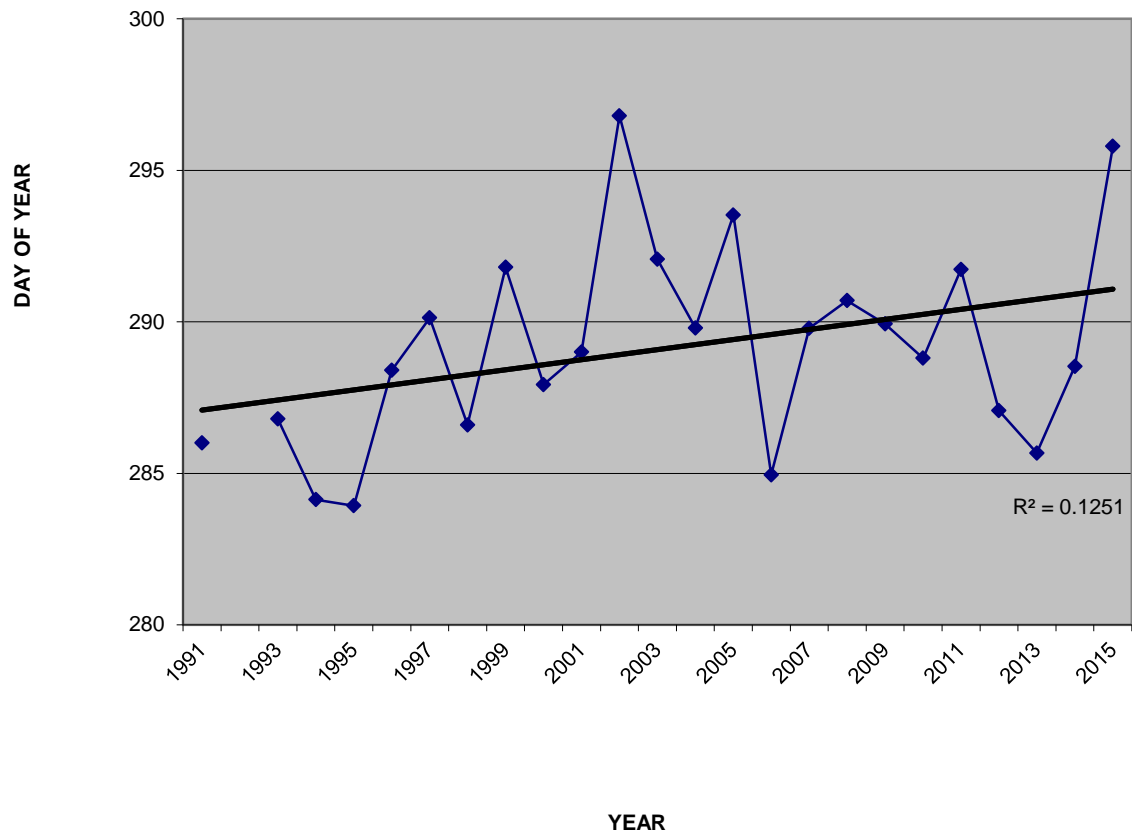




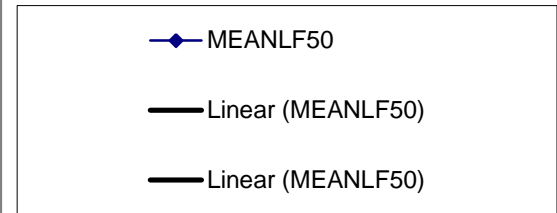
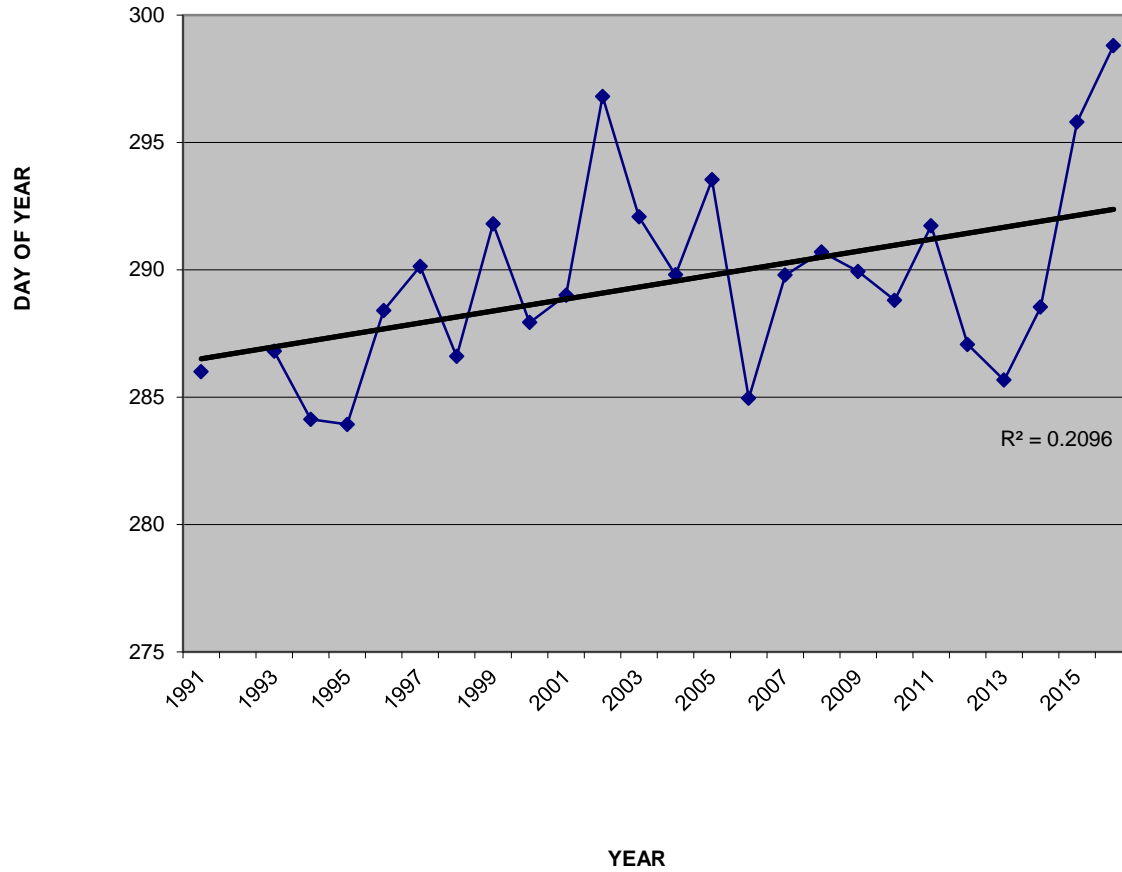
# MEAN LF50 (4 SPP, N=15)



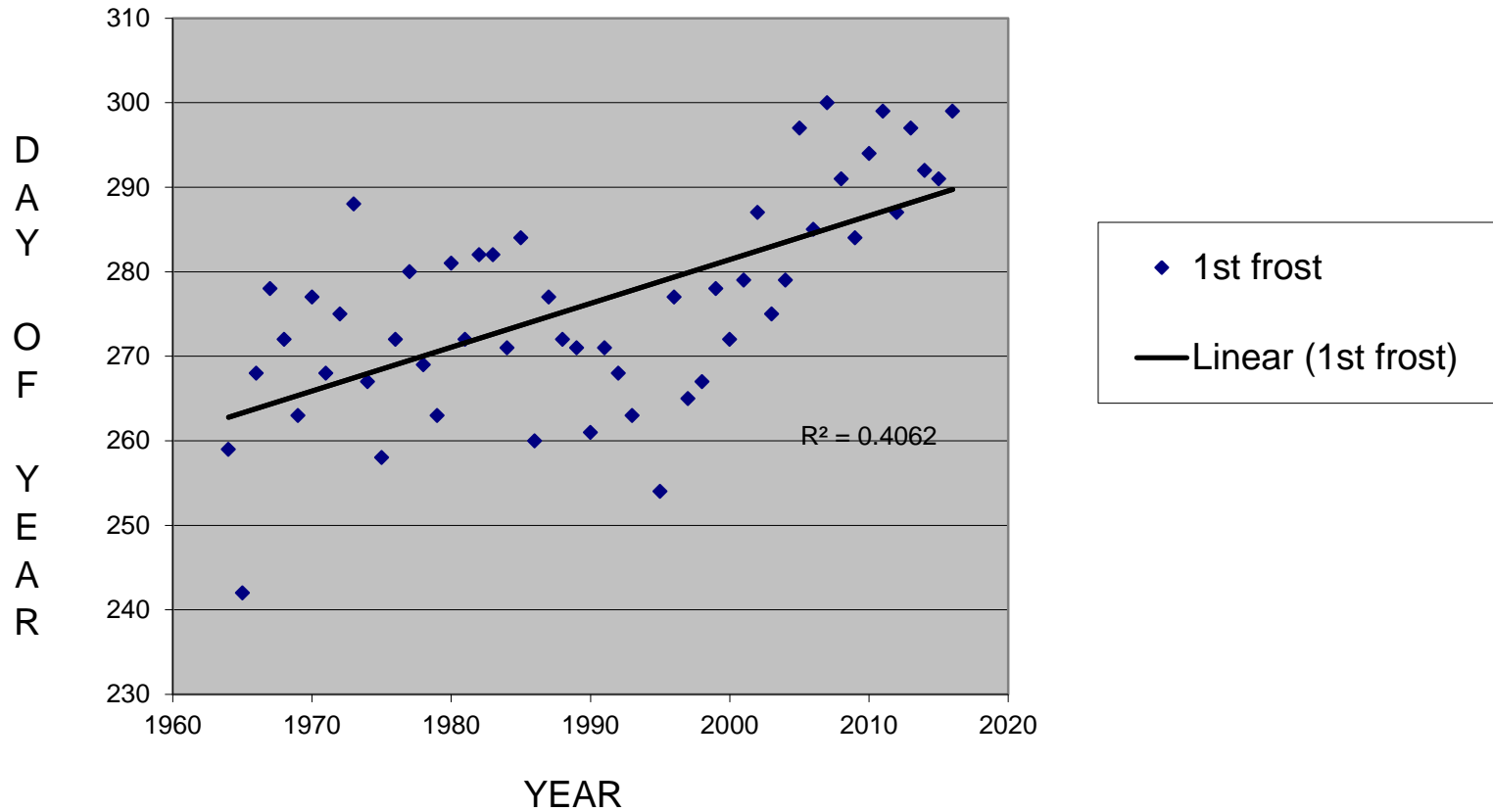
### MEAN LF50 (4 SPP, N=15)



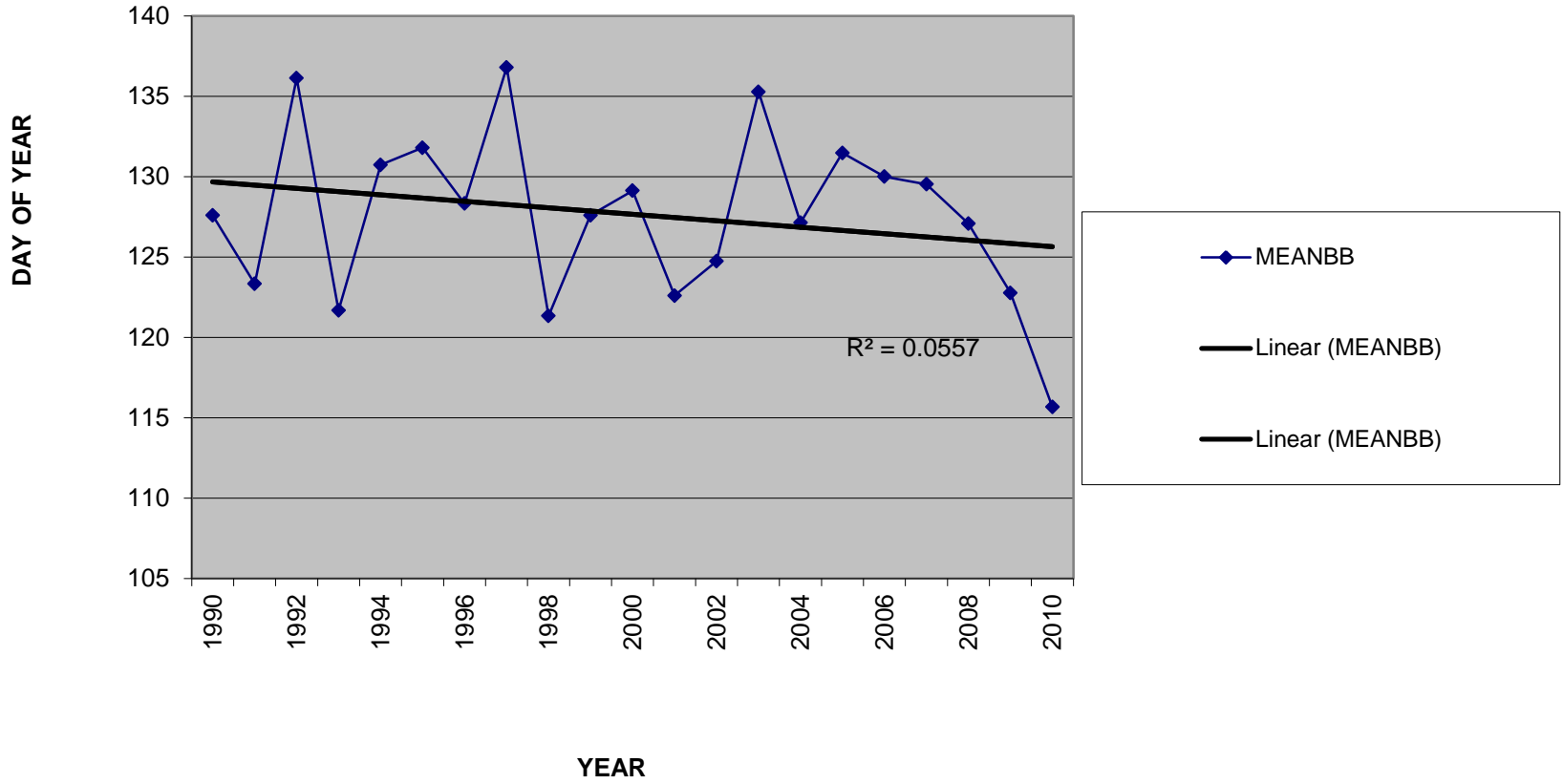
# MEAN LF50 (4 SPP, N=15)



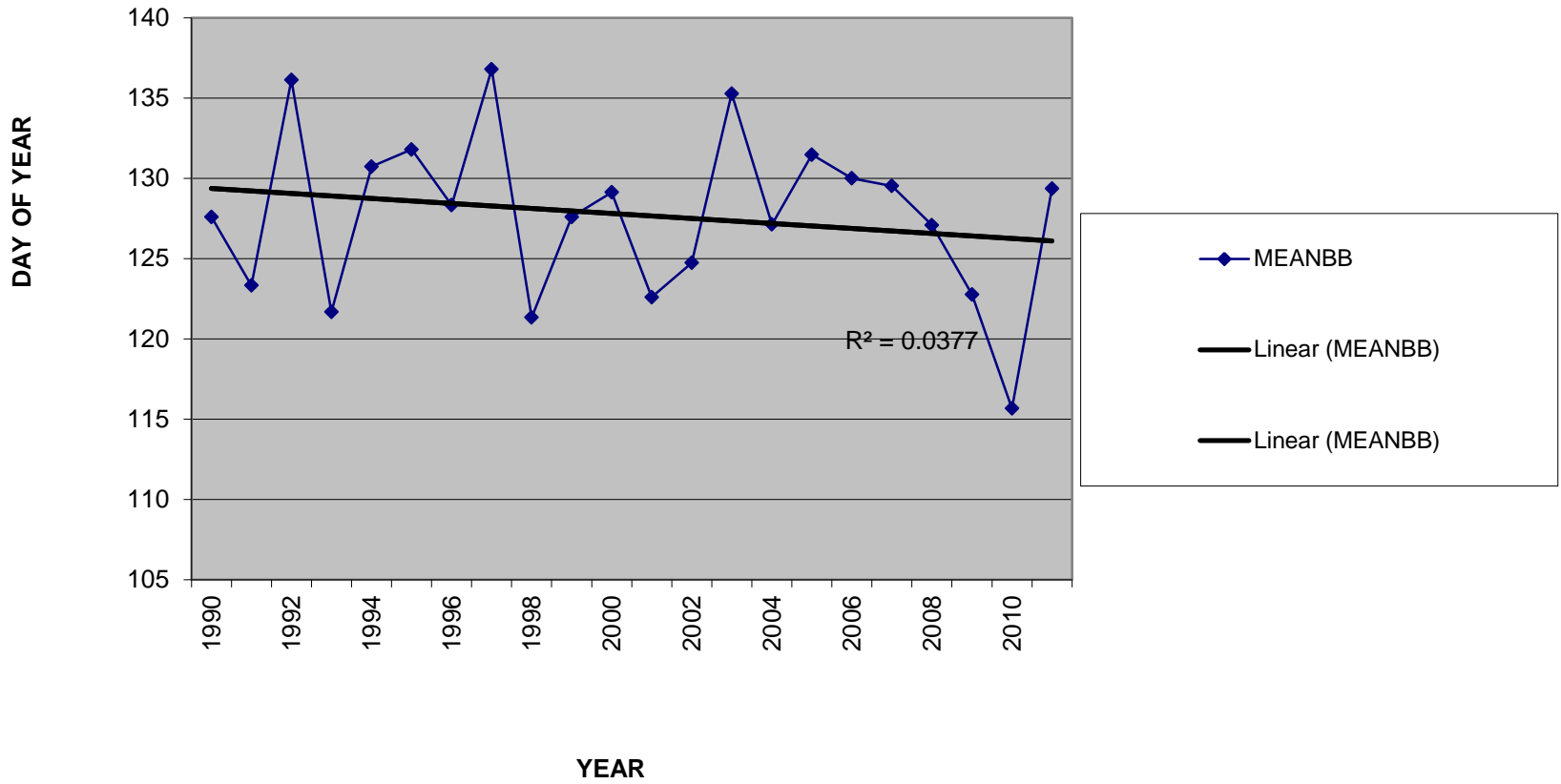
# 1st frost (day of year) 1964-2016



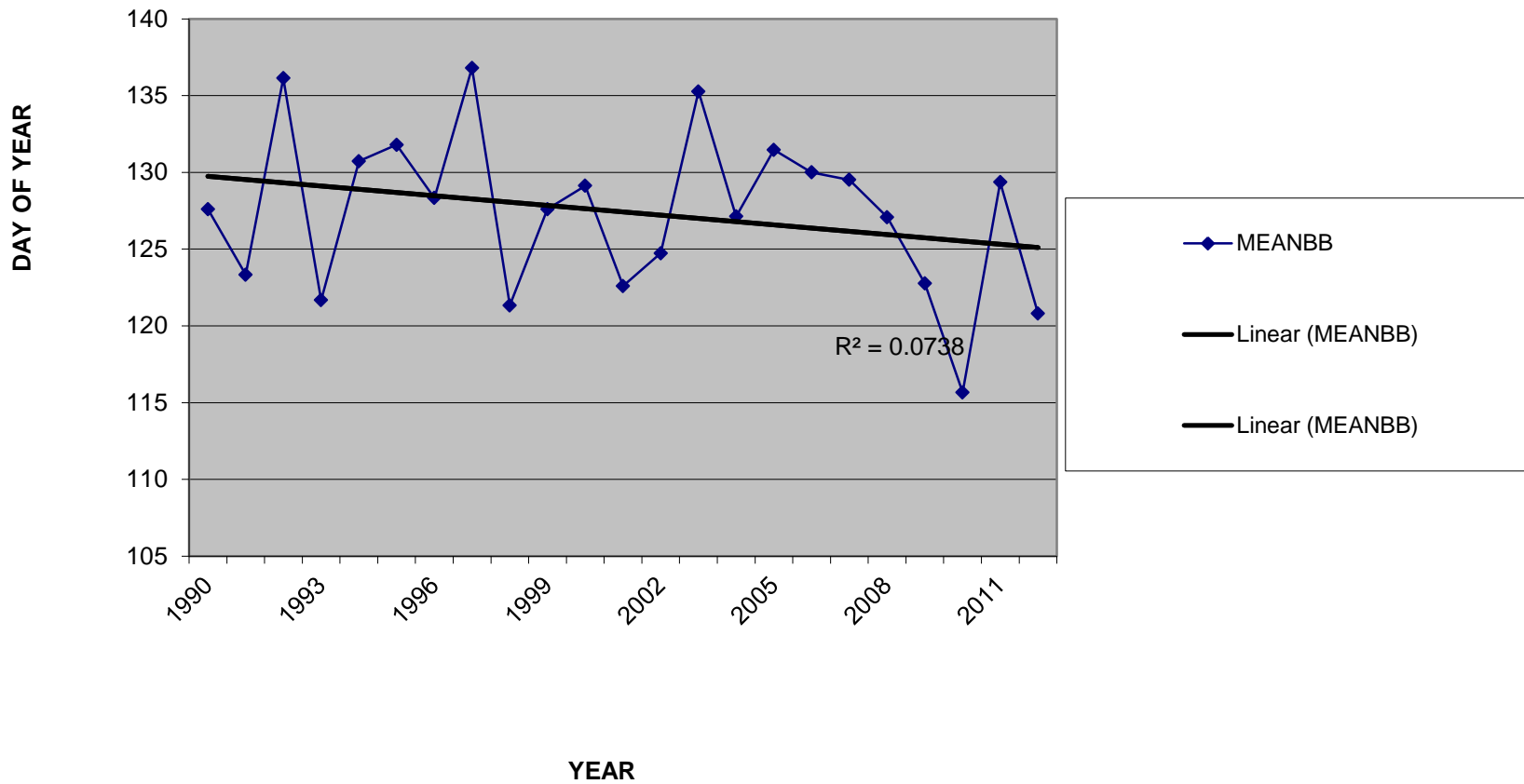
### MEAN BB50 (4 SPP, N=15)



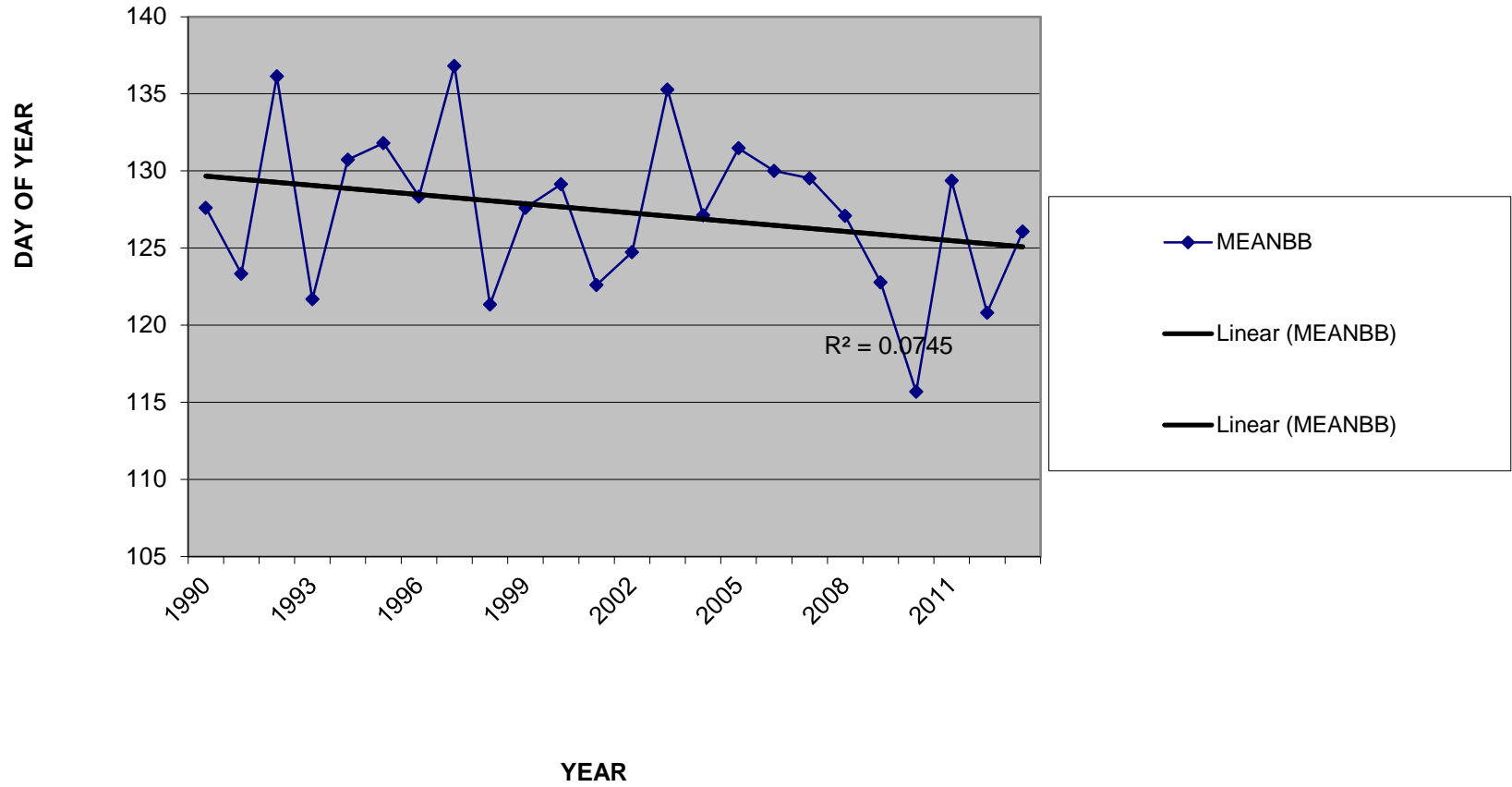
### MEAN BB50 (4 SPP, N=15)



# MEAN BB50 (4 SPP, N=15)

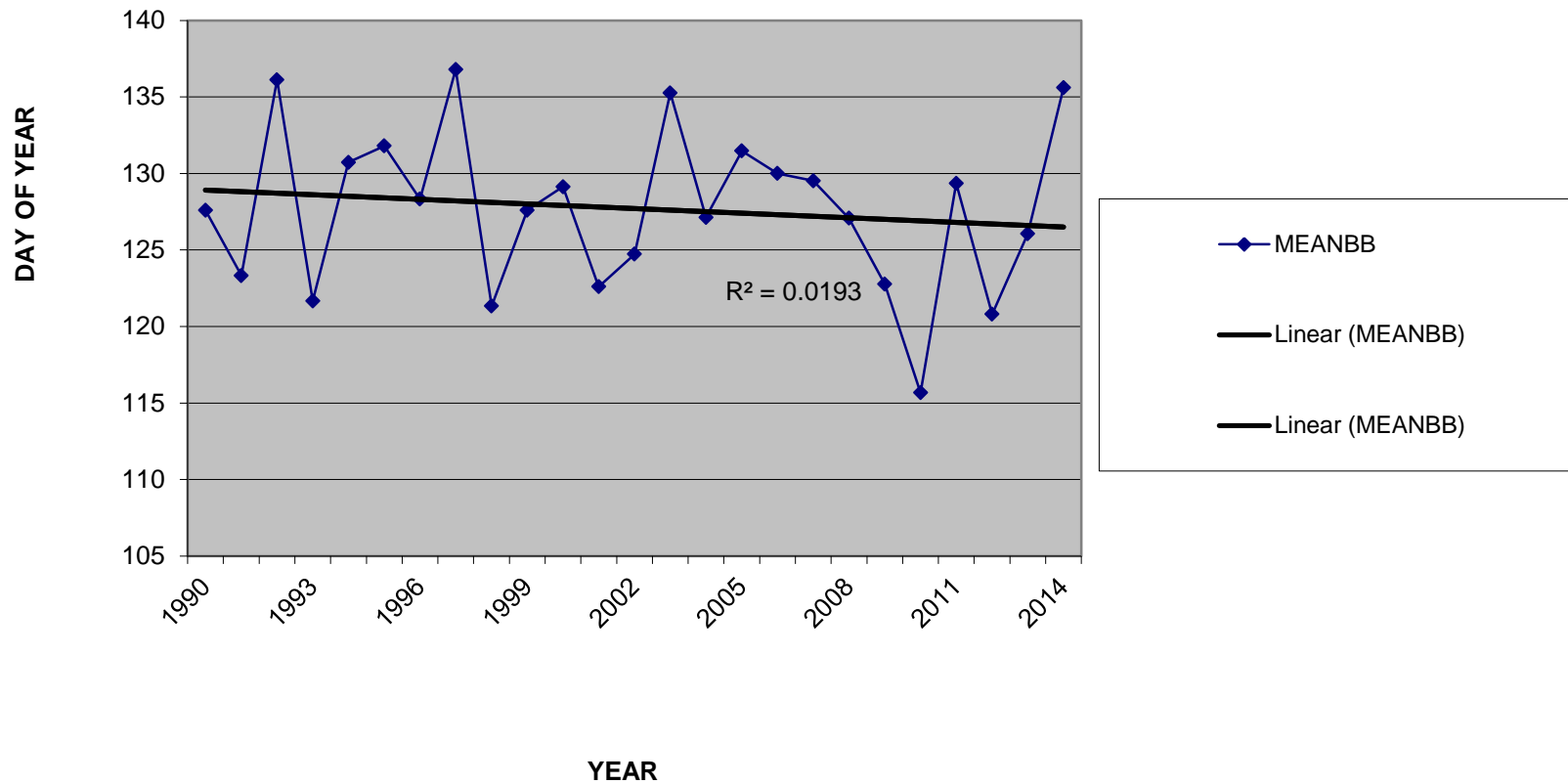


### MEAN BB50 (4 SPP, N=15)

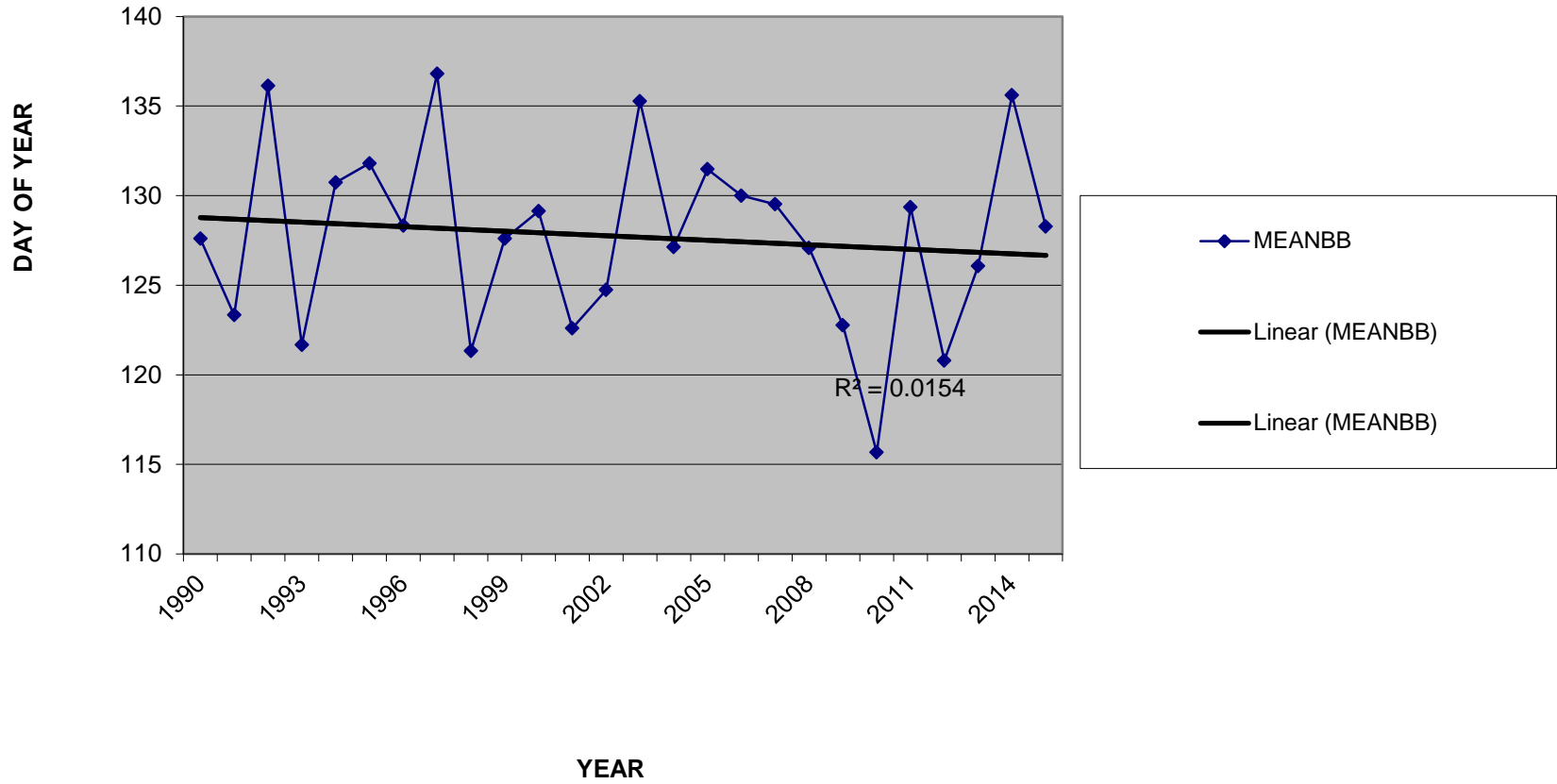




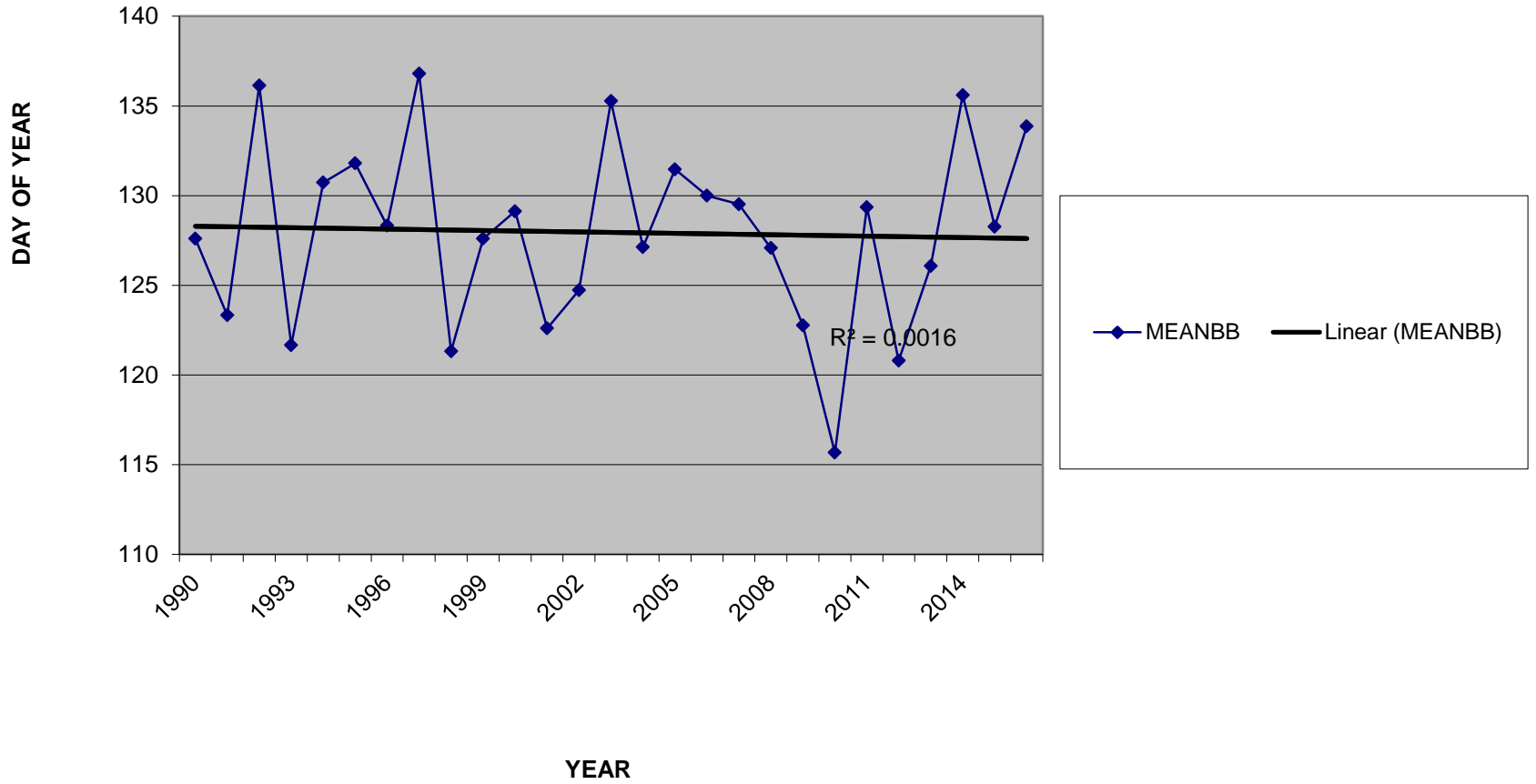
### MEAN BB50 (4 SPP, N=15)



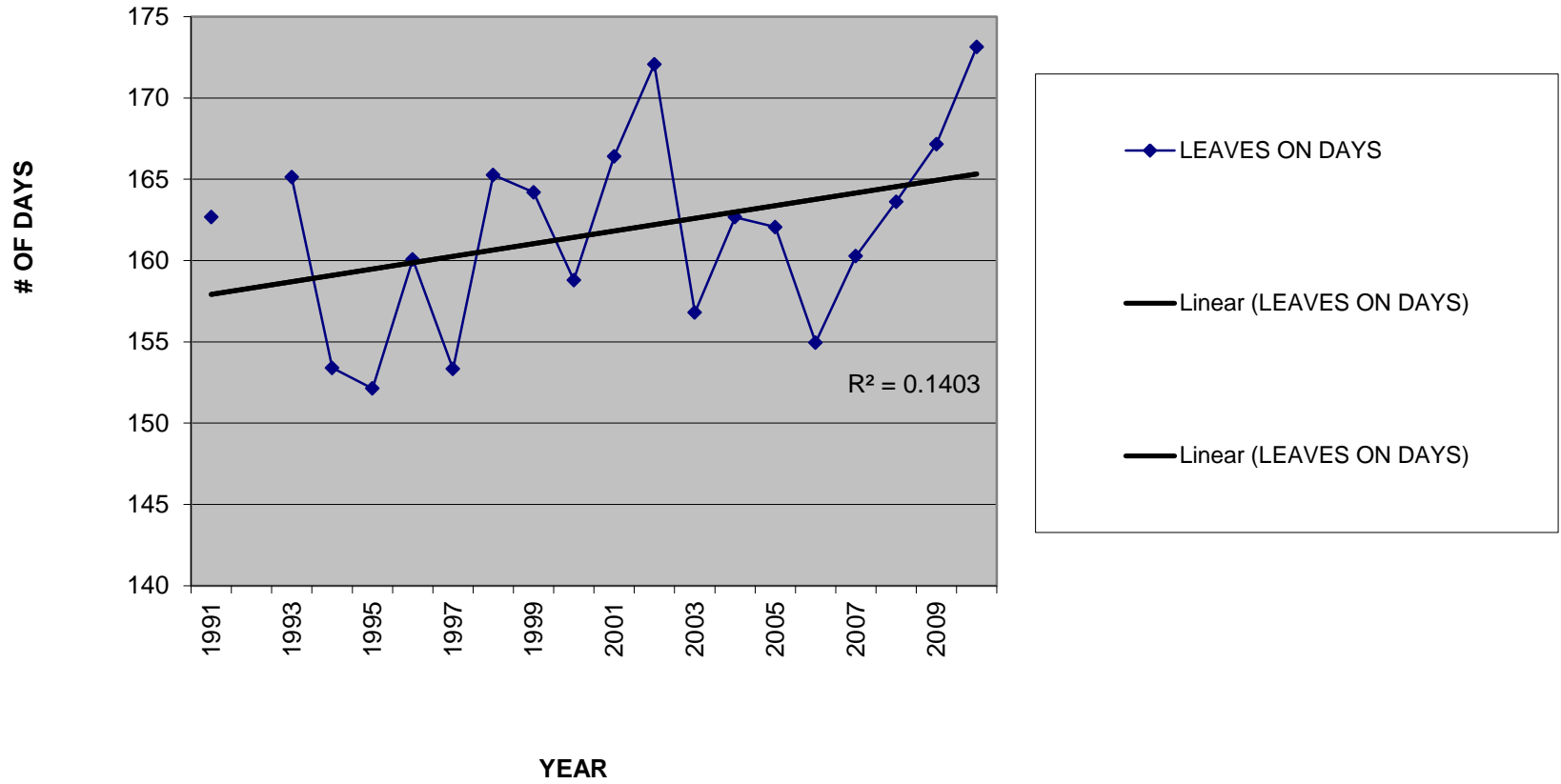
# MEAN BB50 (4 SPP, N=15)



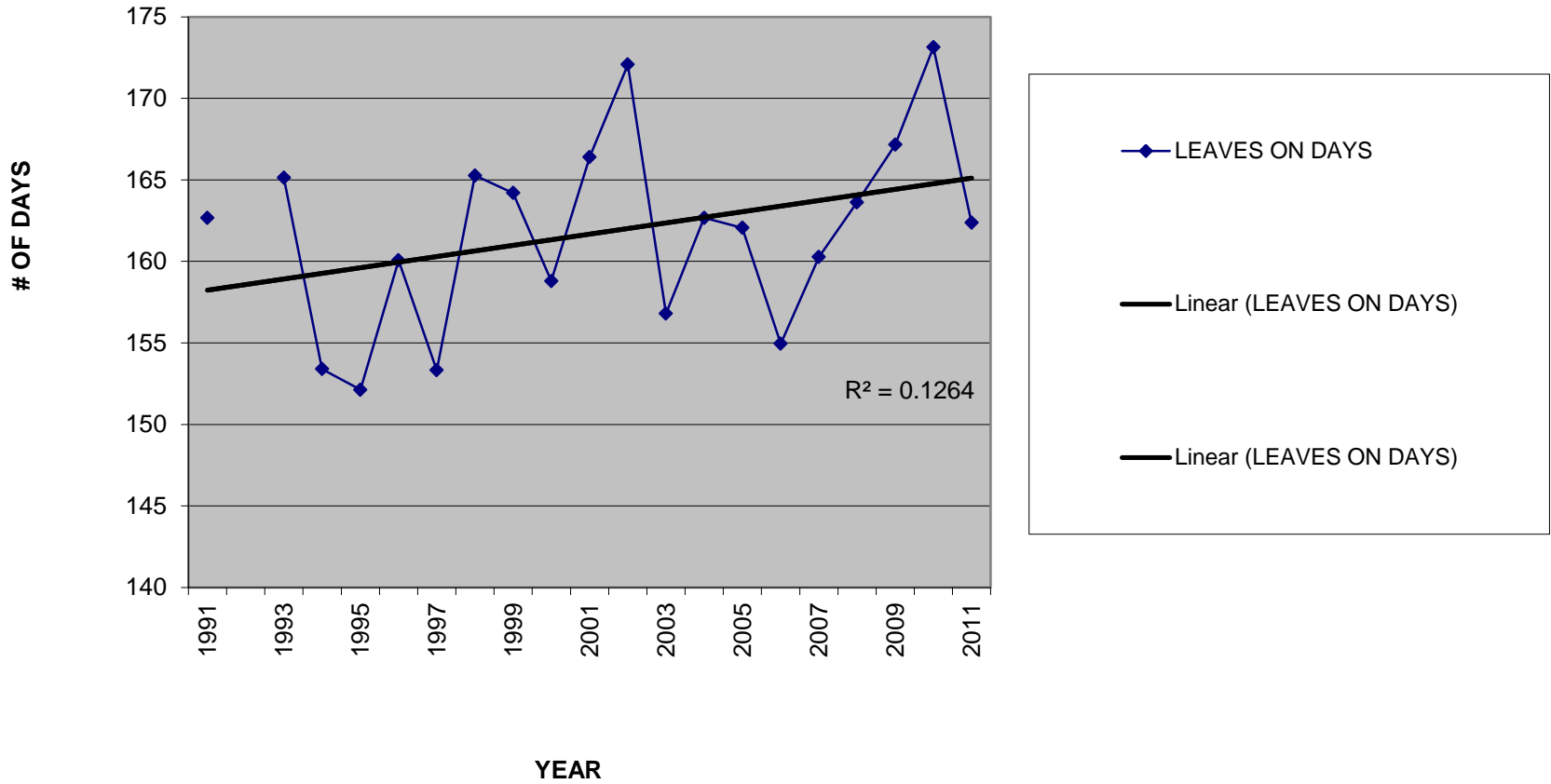
# MEAN BB50 (4 SPP, N=15)



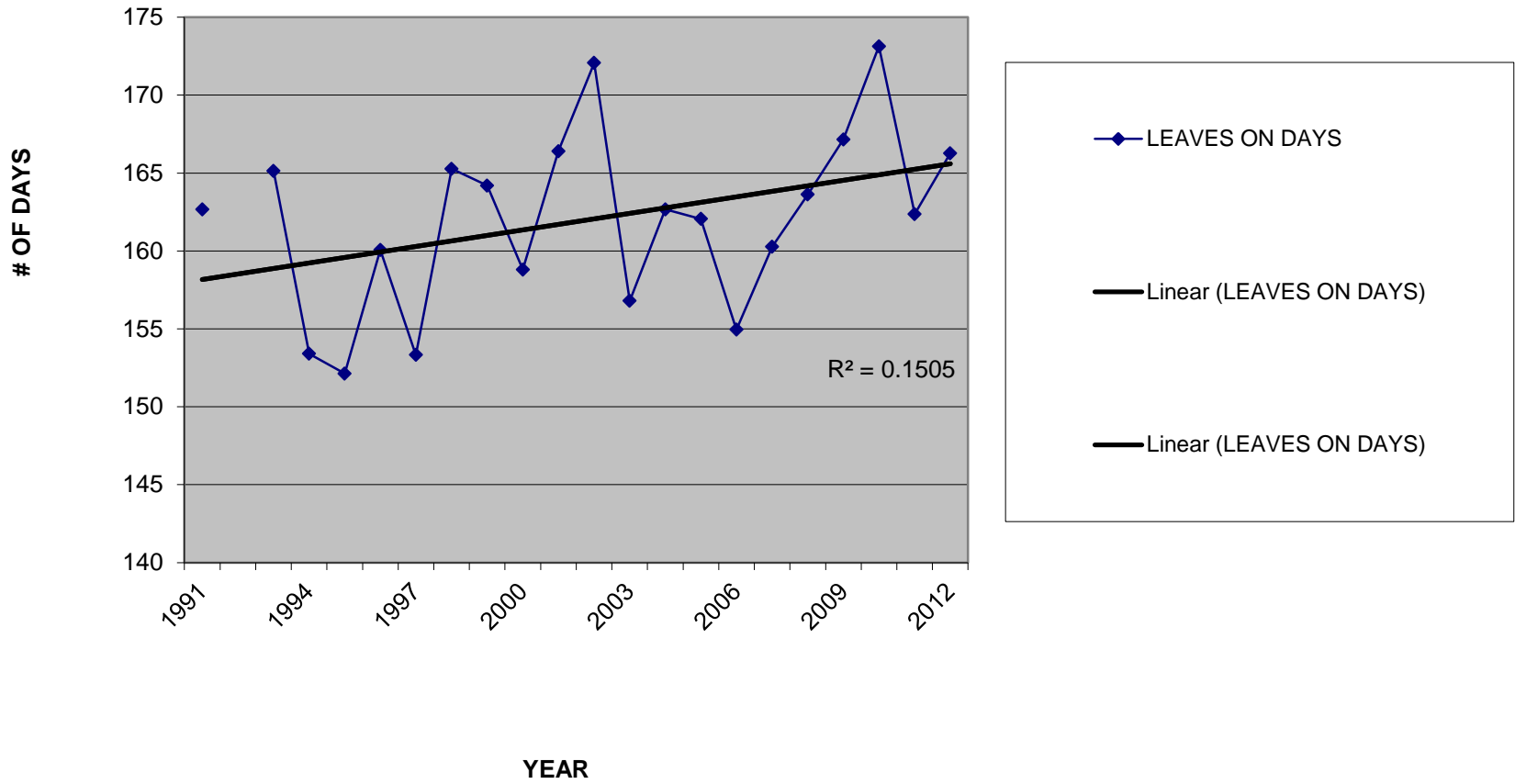
### LEAVES ON DAYS (4 SPP, N=15)



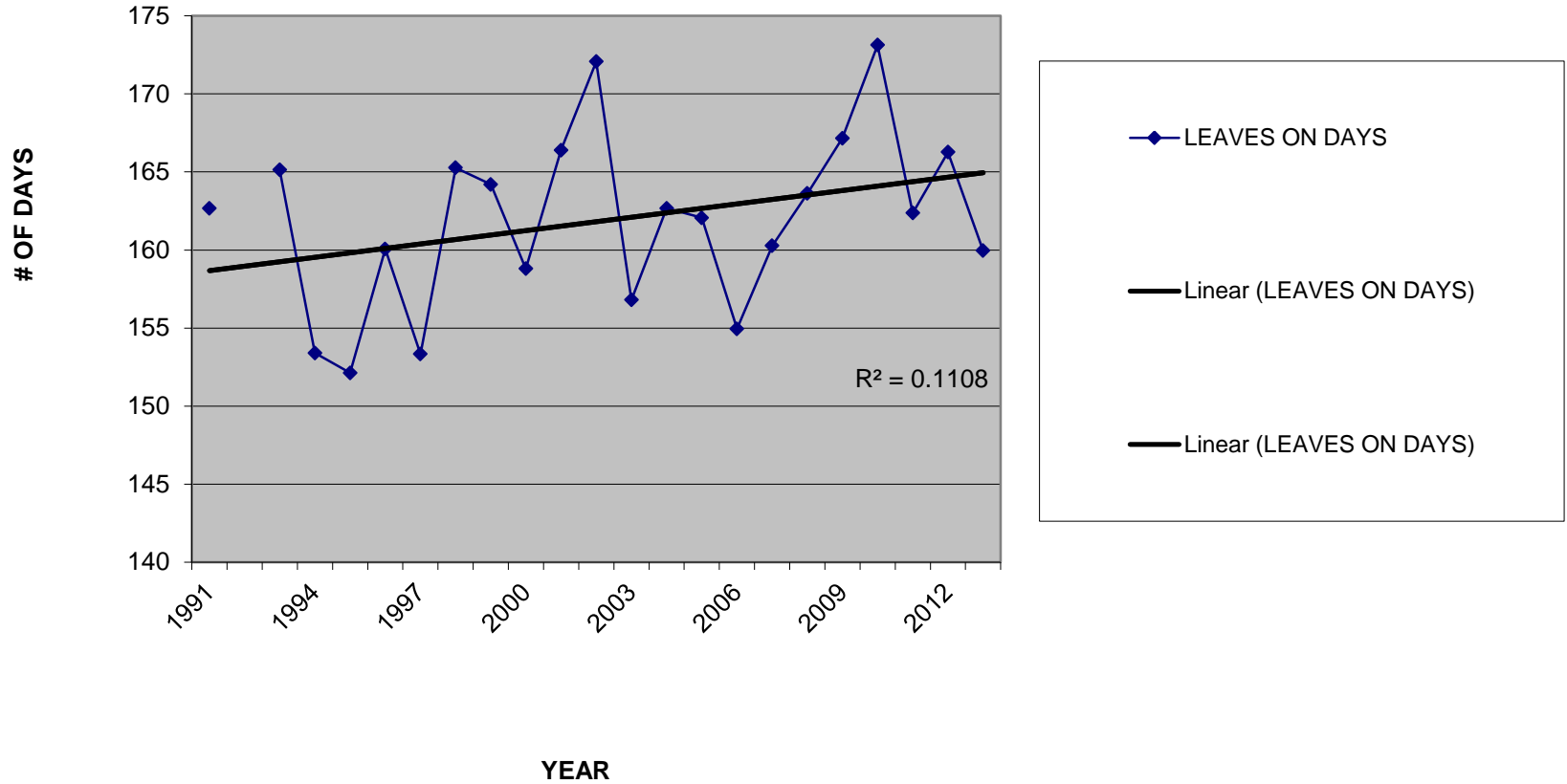
# LEAVES ON DAYS (4 SPP, N=15)



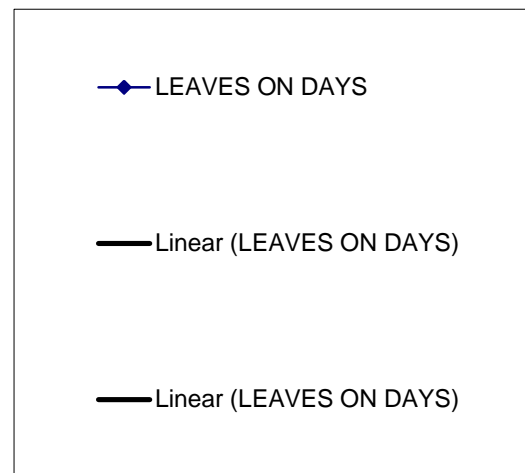
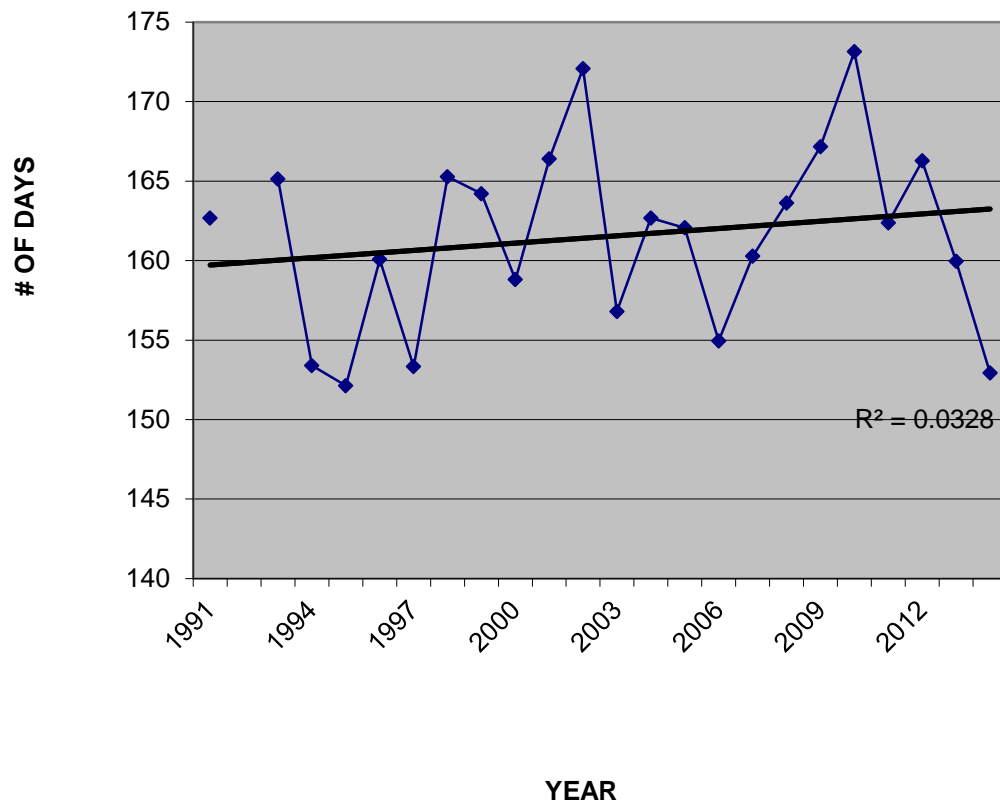
# LEAVES ON DAYS (4 SPP, N=15)



### LEAVES ON DAYS (4 SPP, N=15)

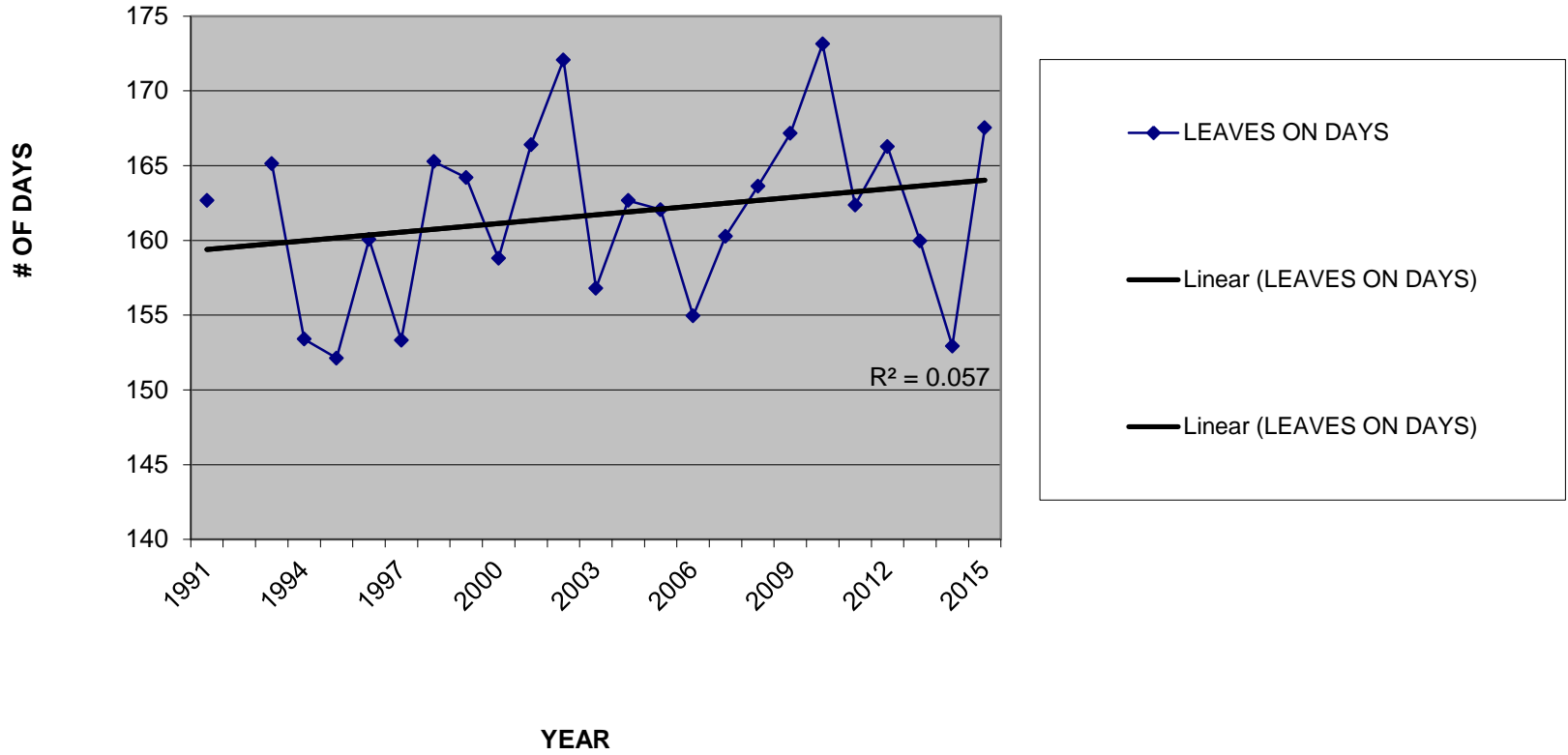


### LEAVES ON DAYS (4 SPP, N=15)





# LEAVES ON DAYS (4 SPP, N=15)



### LEAVES ON DAYS (4 SPP, N=15)

